

FROM



REPORTS

BY THE

Calcutta Engineer Department.

1848-49.

MADRAS.

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Selections from Reports by the Civil Engineer Department on the more important Works executed in the different Divisions during the years 1848-49.

1st DIVISION.

RAJAHMUNDRY 1848.

* * * The following were the principal works executed in 1848.

- 1st. Part of the Godavery Annicut.
- 2d. Repairs of the Thoolia Bagah Channel.
- 3d. Samuleottah Channel.
- 4th. Yanam Embankment.
- 5th. Permanent Railroad at Dhowlaisweram.
- 6th. Road from Narsipoor to Cakarapurroo.
- 7th. Lattice Bridge at Coceanada.

On the Annicut the sum of ¹Rs. 2,74,983 has been expended this year. The opening of the Quarries, laying Railroads, building temporary stone dams, and the construction of the Dhowlaisweram and Muddoor branch Annicuts, with parts of the Locks and Shuices at Dhowlaisweram, Rallee, and Vigasweram were the works of this year.

2d. Repairs of the THOOLIA BAGAH CHANNEL. The repair of this long neglected work commenced in 1846, was continued this year, and Rs. 5,554 were expended on it, under an ordinary estimate making a total of Rs. 18,864 expended up to the end of 1848. The work consisted chiefly of clearing the old channel. The benefit of this was immediately felt. A statement of results will be given in reporting upon the work when farther advanced.

* Note.—Fractions are omitted throughout, except in the totals.

3d. SAMULCOTTAH CHANNEL. The expenditure on this channel, which was an entirely new line, carried from the Thoolia Bagah near its head on the highest level, and begun in 1846, was Rs. 3,064 chiefly for Sluices, the total expenditure up to the end of 1848, being Rupees 21,941.

This work, 27 miles in length, carried through a tract of country before almost entirely without water, excepting some tanks dependent upon the local rains, is a striking proof of the value of water, as the following Statement shews:—

Average collections of 6 years previous	Rs. 25,280
Do. of 1846-7.....	30,480
Do. of 1847-8.....	36,093

4th. YANAM EMBANKMENT. This bank carried along the Eastern side of the Eastern Godavery, was utterly insufficient previous to 1848; in this year the sum of Rupees 7,497 was expended out of an estimate of Rs. 34,994. There is nothing particular to report upon the work of this year.

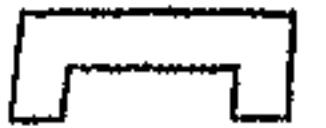
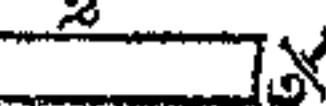
5th. PERMANENT RAILROAD AT DHOWLAISWERAM. This road leading from the Quarry Hill to the bank of the river was intended for the permanent use of the District. The sum of Rupees 5,410 was expended on it this year. It consists of a continuous line of cut stone of about 1 foot thick, laid on broken stone, with a thin batten of teak treenailed down to it, on which a flat iron bar 2 inches $\times \frac{1}{2}$ is screwed. This road has been regularly worked for the Annicut and other works. About 120,000 tons have been conveyed along it on waggons, weighing from 4 to 5 tons gross; most of it has been worked by ponies or men at only 3 or 4 miles an hour, but one end of it adjoining the inclined plane on Quarry Hill was in the 1st year passed at a higher speed, about 8 or 9 miles an hour. It has stood the work very fairly, the repairs amounting to about 1,000 Rupees per mile, for 120,000 tons, or at the rate of

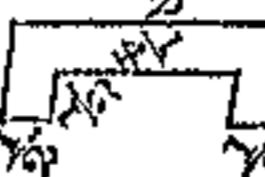
$1\frac{1}{2}$ pice per ton per mile. The cost of working it with ponies was found to be greater than by men. The cost of draught has been by the latter 10 pice per ton for $1\frac{3}{4}$ mile; but this includes the working of the inclined plane into the Quarry, which the frequent delays from loading and discharging on so short a line, makes the principal part of the expence. The expence of working by men on such a road on a level is about as follows:—

5 men to push 3 tons weight 10 miles per day and return with the empty waggons ...	8	0	0
Or for 1 ton 1 mile.....	0	0	$3\frac{1}{4}$ pice
Add for repairs of road and waggons ..	0	0	2
Total per ton per mile..			<u>0 0 5$\frac{1}{4}$ pice</u>

This does not include management, but merely draught and repairs on a line amply strong for the loads and speed used.

This road would not bear working at a much higher speed with these loads; with waggons of $\frac{1}{3}$ ton carrying one ton it might probably be worked at 8 or 10 miles, with locomotives of that weight, but for ordinary roads in this country there would of course be little object in carrying goods at any speed, and passenger waggons might be very light. This road would however be greatly improved at very little additional cost, by placing sleepers of about 4 by 6 over the stones, instead of the light timbers used here,

and by fixing on them the new patent rail  , a remarkable improvement upon the perfectly flat bar, the stiffness of a bar being as the 4th power of its depth, it will be obvious how very greatly the efficiency of the rail may be increased by giving it this form with the same weight of iron. Instead of the Section  here

used, they might have  the stiffness of the latter

would be about 4 times that of the former with the same weight of iron. The weight is 17 tons per mile for a single way, or 1,700 Rs. of iron in this country.

I consider this as a very useful experiment; stone is certainly the cheapest material in most parts of this country by which to obtain the *strength* requisite to bear a load. If the whole weight is borne by iron it must be far more expensive.

I should also remark that for a constancy I should prefer working the road as it now is with lighter loads, viz. not exceeding 2 tons gross, with which, I think the repairs would be reduced to a trifle.

6th. ROAD FROM NARSIPPOOR TO CAKARAPURROO. The sum of Rupees 4,400 was expended on this work in 1848, out of an estimate amounting to Rupees 13,294. Its length is 24 miles, it is intended to connect Narsipoor with Rajahmundry, the line between Cakarapurroo and Rajahmundry lying along the River Embankment is always practicable. This work has been of great use, but from the lowness of the country through which most of it passes, it will always require a considerable expenditure after every monsoon, till the draining of the country has been got into order.

7th. LATTICE BRIDGE AT COONADA. The sum of Rupees 1,065 out of an estimate of Rupees 2,637 was expended this year upon this work, which was finished in 1848. The total sum at which it was contracted for was Rupees 2,400 but the Contractor has not yet received the balance of his contract, refusing to sign a receipt and pleading that work was done which was not in the contract, and that it has cost him far more than the sum agreed for.

This was a first experiment to ascertain the cost and efficiency of a mode of construction so extensively used in

America, and which has also been adopted in England. It's length is 240 feet between the Abutments in 3 Bays of 50 feet each, and 2 of 40 feet. As there is no practicable road from there for bandies, and the country is so intersected with creeks, and as also all the heavy traffic is by water, it was intended to make this merely a foot bridge, it was however made 8 feet wide so that if occasionally a wheel'd carriage might require to pass, it might do so. The contract cost of this bridge was 2,400 Rupees, if it has actually cost 3,000, it still gives only 12½ Rupees per foot of water way, or 1½ Rupees per square foot of surface, a very low cost for a bridge built in a tide way. It has been of the greatest use, many thousand people passing over it daily. The plan seems to answer admirably for this district, and it would be still more suitable in some other parts of the country. Where there is a deep creek or a mountain stream with a deep ragged channel of a breadth not exceeding 150 feet, a bridge of this sort might be thrown across from bank to bank without any piers, and also out of the reach of injury from the torrent or from drifts. The cost of renewal would in most places be much less than the interest of the additional sum required for a Masonry bridge. The annual cost of this work may be thus calculated.

Interest on 3,000 Rs. at 5 per cent.....	150
Repairs	100
Renewal of Timber Work (1,500 Rs.) once }	45
in 20 years, 3 per cent.....}	
Annual cost Rs.....	295
or per day 13 Annas.	

If 5000 people pass it per day, it gives 1 Pie for every 30 people who cross it.

But of course while the present system of paying for Public Works out of the revenues of the country is continued, by far the most important advantage in such a work is the diminution of present outlay.

The last time I had an opportunity of examining this

work, it was in perfect order, and shewed no symptoms of inefficiency.

This bridge is also a work of peculiar importance with reference to the question of bridging the great rivers of this Division. There is a particular difficulty connected with such an undertaking. The surface of the water in the freshes is 3 or 4 feet above the ground at the edge of the river, the under part of the Arch of a Masonry bridge must therefore be several feet more above the ground, and when to this is added the thickness of the Arch and the road material, it would make such a structure absurdly high. But besides this, it is at the very top of the freshes that the heaviest drifts come down, and unless the Arches are made many feet above the water, there would always be danger of heavy drifts striking the bridge, and if they did not at first seriously injure the Masonry, they might form the nucleus of an immense accumulation, which might cause the destruction of an Arch, in which case all would follow, or at least all that were not cut off from the rest by Abutment Piers. If then instead of Arches, a timber platform were laid with wide bays of suppose 100 feet, a much clearer water way might be allowed under the flat form, without making the roadway of the bridge any higher, and which is the most important point if one bay were destroyed, the rest of the bridge would be uninjured. If the bridge were to be built over the Annicut, such a work would also have the great advantage of fewer and thinner Piers offering far less obstruction to the water.

In this report I have not entered into any particulars about the Annicut, because 1st It was only just begun, 2d It has been and must yet be repeatedly and specially reported on, and 3d It would require so much more time and space than seems suitable to the nature of such a report as this,

(Signed) A. COTTON, Lieut. Col.

Civil Engineer, 1st Division.

RAJAHMUNDRY 1849.

* * * The principal works executed in this Division during the year 1849 were

I. The continuation of the construction of the GODAVERY ANNICUT.

II. The repair and improvement of the THOOLIA BAGAN CHANNEL, including the construction of 2 sets of Locks and Calingulahs to render it a navigable canal.

III. The repair of the SAMULCOTTAH CHANNEL.

IV. The construction of a portion of the YANAM EMBANKMENT.

V. The construction of the NARSIPPOOR ROAD, and the erection of Bridges thereon.

1. It will be convenient before entering into a description of the progress made in 1849 with the construction of the Annicut to mention briefly the state to which the works were advanced at the termination of the working season of 1848.

The body of the Annicut across the Dhowlaisweram, or 1st Division of the river bed, was built quite across that branch to the height of 9 feet, and a rough stone apron averaging about 6 yards of section was laid ; the head sluice lock and under sluices were all well advanced towards completion ; and the western wing walls with the embankment across the lunka, separating the Dhowlaisweram from the 2d or Rallee branch, were finished.

The latter branch was partially closed by a rough stone dam a few feet only in height, the wing walls at its eastern side were nearly completed, and on the western side, the foundations of the under sluice and wing walls were laid. On the central tract, the head sluice across the main irrigating channel was considerably advanced, and the adjoining lock had its foundations laid across the 3d or Muddoor branch, the body of the Annicut was built to the

height of 9 feet, and the wing walls on the western side were completed. A very early fresh however breached this work and otherwise injured the new Masonry. The embankment across the Muddoor Lunka was completed. The 4th or Vigasweram branch, like the 2d or Rallee, was partially closed by a weak rough stone dam only a few feet in height. The wing walls on the eastern side were partly built but were afterwards destroyed by the freshes. Those on the western side were about half completed, and were connected with the under sluices by an embankment of 500 yards in length. The under sluice and head sluice were a little advanced but the lock had only its foundations laid.

Thus it will be seen that, owing to numerous and unlooked for difficulties, no considerable progress in the actual construction of the Annicut was effected up to the end of the season of 1848. On the other hand however, the quarry from which the stone required is obtained was opened out to a great extent, and was connected, by two double lines of railway, directly with the bank of the river the plant and apparatus, including waggons, two serviceable steam tugs and a third nearly ready, and boats, capable of transporting 500 or 600 tons of stone at a trip, were placed in the most efficient working order the prejudices of the people against the work and employment thereon were dispelled, and much experience was acquired.

It was therefore with the fairest prospects of success that on the sanction of the supplemental estimate of Rupees 4,07,505 prepared by the Committee ordered by Government to report on the Annicut, the works were reopened about the middle of February, and were vigorously proceeded with till the coming down of the river on the 20th of June; by which date, notwithstanding a serious accident to the temporary embankments and to the all but completed masonry dam across one branch, the Annicut was built to a height of from 9 to 10½ feet quite across the

river, with the exception of about 600 yards of the 2d branch, which were closed with a rough stone dam 6 feet high; two of the three sets of sluices and locks were finished; and large quantities of stone were deposited as aprons and other defences to the work.

The work performed this year towards the completion of the Annicut was by measurement

Cubic yards of Rubble Masonry	28,235
" Brick Masonry	4,493
" Cut Stone Masonry	980
" Loose Stone	44,885
No. of Wells.....	1,326

but these figures convey no adequate idea of the real extent of work actually accomplished, because they do not show the vast extent of labour expended on the preliminary and difficult operations of constructing large temporary dams, and forming many miles of temporary embankments and canals, all of which, though necessary for the prosecution of the main work, form no part thereto.

The expenditure in 1849 amounted to Rupees 1,55,641 making the total cost of the Annicut up to the end of that year Rupees 6,59,344.

The stability of the structure though so new and in so unfinished a state, was remarkably tested and proved by the unprecedentedly high and long continued freshes of the year 1849, which caused little or no material injury to the work.

2. TUGOLIAR BAGARI CHANNEL. The repairs performed to this important irrigating channel in 1849 under the head of "ordinary" involved an expenditure of Rupees 9,126, and under the head of "emergent" Rs. 2,249. Of the former sum Rupees 1,924 were expended on clearing out the usual annual deposit which each year, to a certain extent, fills the upper part of the beds of all channels supplied by a river like the Godavery, the water of which

brings down a large amount of alluvion in suspension, and in cutting away several circuitous bends which impeded the free flow of the stream. Rupees 1,048 were expended in clearing out the mud collected at the upper part of the Cocanada river into which the Thooliah Bagah empties itself. This work was required to render the upper portion of the Cocanada river navigable up to the site of the lock at Covoor. Rupees 1,155 were spent in raising and repairing an extensive embankment on each side of the channel, near Chintapilly, known by the name of the Gollivano Ghuttoo, which retains the water in the channel, preventing it from spreading out over the adjoining lowlands.

The outlay of Rupees 2,249 was incurred on emergency in strengthening this embankment during the floods and heavy rains of the season, and in repairing it after they had passed—a necessary measure to prevent injury to the neighbouring lands, and to retain water for the irrigation of the valuable crops dependent on the channel.

The importance of the improvements made since 1846, and the value of a full supply of water to even previously irrigated lands are conspicuously shown by the amount of the revenue derived from this channel before and since that year.

Average collections for 6 years from 1840 to 1845 inclusive before improvement.....	Rs. 34,541	Increase,
Collections of 1846	42,561.....	8,020
,, 1847	44,471.....	9,930
,, 1848	50,785.....	16,244
,, 1849	52,232.....	17,690

The Annicut being now in full operation the increase will probably be still more marked after this year.

The Masonry of the Locks and Calingulahs at Covoor and Chintapilly, required to render this channel navigable,

and sanctioned under an occasional estimate in 1848, was also executed during 1849, at an outlay of Rupees 7,603; but as the freshies were down before the Lock gates could be fixed, the channel was not that season open for boats. The floor of the Lock at Covoor being 3 feet below the level of low tide, much difficulty was experienced there in getting the foundations down, and in building the floor of the Lock basin, as the soil was a loose quick mud, and salt water oozed through into the excavations very rapidly, notwithstanding a dam to exclude the tide being thrown across the creek some distance below.

The whole of the work rests upon wells.

At Chintapilly the foundations being good, the Lock and Oalingulah were built without difficulty.

3. On the SAMULCOTTAN CHANNEL the sum of Rupees 1,580 was expended in clearing out the annual deposit, and in strengthening the banks where they were weak. The revenue derived from the lands under this channel has been steadily increasing since its formation in 1845, as shown in the following statement, giving another proof, if such were wanted, of the value of water in this country.

Average collection for 6 years

from 1840 to 1845 inclusive	
before the formation of the	
channel	25,280..... Increase.
Collection of 1846.....	30,486..... 5,206
" 1847.....	36,093..... 10,813
" 1848.....	42,940..... 17,660
" 1849.....	47,910..... 22,630

and there is no doubt that as the influence of the Annicut in giving a more abundant, more certain, and more continuous supply of water is felt, rice cultivation will still further take the place of less valuable crops, and every available acre of hitherto waste land will be profitably cultivated, to the advantage equally of the Ryot and Govern-

Length of wing wall.....	8 "
Average thickness of do.....	3 "
Height of do.....	10 "
Width of rough stone apron	6 "
Thickness of do	2 "

This Annicut was constructed for the purpose of damming up the water which flows down the River, so as to keep a depth of not less than 4 feet in the Croostarazoo, Channel which supplies irrigation to a tract of country paying Revenue to the amount of Rupees 15,900. The work I believe was executed by a Contractor, overlooked by Officers of the Engineer Department—and has been reported as properly constructed. The cost of the Annicut work was 1,950 Rupees. The accessory works such as the 2 Calingulahs and Irrigating Sluices amount to Rupees 1,237. The total cost of the project with the exception of a small sum for excavating accumulations in the Channel amounted to Rupees 3,187.

2. The POOLAPURTY ANNICUT constructed across the Pundaroo River, is a work similar to the above varying only in its dimension. Its use is to cause the water which comes down the River, instead of running waste to the Sea, to be stored up in several Tanks or Reservoirs, to which it is conveyed by means of a Channel led off from the Annicut itself, and affords irrigation to lands in the Survasiddy Talook assessed at Rupees 11,600.

As these Rivers for the most part, take their rise in the ranges of Hills which form the Eastern Ghauts, they are invariably supplied to a certain extent every year; and such works as the Poolapury Annicut prove of essential service in years when the freshes are low and combined with local rains.

The cost of the Poolapury Annicut was Rupees 1,526 and of the accessory works Rupees 186.

4. The ANNICUT across the PRDDA OOPALEM CHAN-

nel, is a work somewhat similar to those already described. The purposes for which it was constructed are however different. It is erected over the Pedda Oopalem Channel, which is a branch from the River Pundaroo, but from having a straighter course, a greater fall, and a large breach in one of its banks, it gradually became deepened out while the opposite side of the bed of the Pundaroo itself became raised. The consequence was that all the water in low freshes found its way down the Channel and out again by the breach above mentioned, and which is called the Buswapadoo Cundey Ghuttoo; the irrigating channels led off from the Pundaroo were thus left without water. It became necessary therefore, to turn the River into its right course, and only allow to flow down the Oopalapoo Channel as much as was required for the cultivation under it. This the Annicut is intended to effect, as the bed will naturally silt up to the height of the Annicut, and the water being carried into the Pundaroo, will sweep away the accumulations which had been previously deposited; what the effect has actually been I am not able to state, not having had an opportunity yet of visiting the spot.

The cost of the work and its accessories of filling up the breach, &c. amounted to Rupees 830.

(Signed) F. H. RUNDALL, Lieut,
1st Asst. Civil Engr. Sub Division.

MASULIPATAM 1848.

ROAD AND BRIDGES AT GOODEWADAH ON THE HIGH ROAD BETWEEN ELLORE AND MASULIPATAM.

Four good substantial Bridges have been built on the high road between Ellore and Masulipatam across irrigating channels at a total cost of Rupees 4,029 making the passage of these channels now practicable for bandies at all seasons. To prove the inestimable advantage of these

Bridges, it is calculated that nearly 40,000 Bullocks pass over them yearly with Salt alone, to the Hyderabad Territories, which before were weeks in the monsoon waiting, till the water fell, to ford the rapid streams.

The amount of money laid out on a part of the road at Goodewadah has proved the practicability of economically constructing a good and sound road over black cotton soil, effective at all seasons. The materials of this road were taken from a mound of old burnt bricks and earth.

I proposed that this earth should be calcined without being moulded into bricks which would make the material much cheaper and as efficient, and where firewood is procurable in large quantities, I believe a good serviceable road can be constructed for about 350 Rupees a mile.

(Signed) F. APPLEGARTH, Lieut.,
Asst. Civil Engineer.

MASULIPATAM 1849.

THE KRISTNAVAREM LIME KILN. The very great importance of obtaining Lime at a moderate cost in this District is too well known to need comment, and being well aware that it could be procured at a much cheaper rate than the price demanded in the District, sanction was obtained to construct this Kiln at the Lime Stone Quarries, which were worked 23 years ago, by the D. Company of Sappers and Miners, since which they had never been used.

Most excellent Chunam is now procurable to any extent 50 per cent cheaper than it could be obtained before, and the reopening of these Quarries and erecting the Lime Kiln (the cost of which was Rs. 143) will be of the greatest service in supplying Lime for all the contemplated Bridges on the No. 6 Trunk Road.

(Signed) F. APPLEGARTH, Lieut.,
Asst. Civil Engineer.

2D DIVISION.

NELLORE 1848.

* * * There were 3 projects for the improvement of the revenue. The first work was the improvement of the Survapully channel which leads off from the Pennair river, and after running a course of nearly 3 miles, branches into 3 channels.

It passes on the western side of the Town of Nellore, and is spanned by 3 Bridges and an Aqueduct. One of the former works was built by the Prisoners in 1845-46 of Laterite stone. It consists of 3 semicircular arches of 12 feet span each—springing from piers 6 feet high, and having a roadway 33 feet clear. The other works were very small, and offered a great obstacle to the free passage of the water down this channel. One of the Bridges consisting of 2 semicircular arches of 9 feet span each, has been removed altogether and replaced by one of 2 elliptical arches of 18 feet span each, having a rise of 6 feet—springing from piers $5\frac{1}{2}$ feet high, giving a total height from the bed of the channel to the intrados of the arches of $11\frac{1}{2}$ feet. The roadway is 30 feet clear. The other Bridge and Aqueduct were at the same time enlarged by an additional arch.

5. All these works are built of Laterite stone, which is found in abundance in Nellore. The actual expense incurred on account of these improvements was Rs. 1,230.

. 6. About the same time these improvements were under execution the channel which had never been repaired since it was first cut, (though large sums of money used to be expended almost every year, clearing its head from the deposit brought in during the freshes of the Pennair) was also improved—for finding this channel after the first mile, exceedingly serpentine in its course, and where it had been cut through Laterite rock, the width was frequently re-

duced from 10 yards to less than 3, an ordinary estimate was framed for making the channel more direct, and for giving it an uniform width of 10 yards. Rupees 521 were thus expended, which placed about half the length of the channel in a proper state of repair, leaving the last half untouched.

7. In consequence of the work having been left in this incomplete state, no benefit was expected to arise from it. It was however continued and completed the following year, and will be found reported upon amongst the works of that period.

8. The 2d project sanctioned by Government was for an Annicut across the Kundlairoo which is a large monsoon river, rising in the mountains that separate this District from Cuddapah. In its course, it is joined by many tributaries, receiving the drainage of a great extent of country. After it is connected with the Pamelairoo a similar water-course, but larger, it eventually disembogues into the sea by the salt water inlet that flows up between Midda and Coo-lypolium. This is the only outlet for the drainage of the country between the rivers Soornamooky and Pennair, so that the quantity of water that passes down it must at times be very considerable.

9. The object of this work is to afford a better supply of water to the tanks of Budvole Collecoodooroo and Cut-wapully of the Surwapully Talook, but as it was not commenced upon this year, it will be better to reservo any mention of it until I enter upon my report for 1849.

10. The last project was the opening a new channel from the Pennair for the better supply of the Nellore tank. This is a very capacious reservoir capable if properly filled of irrigating 2,143 Goortoos of land, the aynent revenue of which is Rupees 32,167, but of late years the average revenue derived from it is only about Rupees 18,000.

11. This new cut opens out from the Pennair near the

village of Gollacondacoor, and is rather more than 5 miles in length, when it joins the old supplying channel to the Nellore tank opposite the village of Mooloomoody.

12. During the execution of this work much more rock was cut through than was supposed would be found when the estimate was framed. This not only retarded the progress of the work, but enhanced it's cost. As it was however desirable to open the channel if possible for the reception of the freshes of the river, it was considered advisable to make the channel of somewhat smaller dimensions than it was estimated to be ; but after all, the chaunel was not completed in time, still a good body of water passed down it but it was too late in the season to have any effect upon the cultivation. Besides which, it was found that much of the water that entered it returned to the river by the Old Head, and over the Calingulah near the village of Mooloomoody—what further steps were taken the following year to improve and complete this channel, will be found in next year's Report. The actual expenditure incurred this season upon this work was Rupees 6,512.

13. Government also sanctioned a sum of Rups. 2,965 for repairing the bank of the Abasanagrum tank in the Calegherry Talook. During the latter end of 1847 this tank was breached in several places owing in a great measure to the destruction of two tanks situated above it, which poured their waters into this tank when it was nearly full. The Calingulah though a large one was not sufficient to let off this accumulated body of water which rising above its banks caused its destruction. This expenditure was therefore necessary to protect existing revenue.

14. The following Statement shews the revenue derived from this tank during the last five years.

Year.	1844-45	1845-46	1846-47	1847-48	1848-49
Revenue ...	1293	1480	10	2752	1328

15. The annual ordinary estimate for the year amounted to Rupees 39,605 of which Rupees 35,425 were expended upon 256 works. The greater number of these were individually of small amount and were necessary to preserve existing revenue.

NELLORE 1849.

During this year the Talook Cutcherries for the Survapully Talook, and for the Tudda Division, were erected. These buildings are similar in form and arrangement though one is rather smaller than the other.

3. The Survapully Talook Cutcherry is built in the form of a rectangle $66\frac{1}{2}$ feet long by $58\frac{1}{2}$ feet wide, outside measurement. On the inner side, 9 feet from these walls, pillars $1\frac{1}{2}$ feet square and 10 feet high are placed, with a verandah beyond $6\frac{1}{4}$ feet wide. The spaces between some of these pillars are built up for records, Prisoners' rooms, &c. An open space 30 feet long by 22 is thus left in the centre in which the Treasury is built, which is a terraced building 9 feet long and 6 feet wide inside, having a verandah on one side 5 feet wide. At the side the entrance door is placed, there is a verandah 7 feet wide extending the whole width of the building. The Cutcherry is built throughout of brick in chunam, and the beams and breast-summers are of Teakwood, with Palmyrah rafters and reepers. The actual cost was Rupees 2,477.

4. The Bodelingumpaud Cutcherry is 64 feet long by 40 wide, outside measurement. It is also of brick in chunam. The rafters and reepers are of Ceylon Palmyrahs which were purchased at Madras, as was also the Teakwood required. These materials were sent up by the Pulicat Lake, and landed at Tudda, within a mile of the site of the Cutcherry. The actual cost of this building was Rs. 1,717.

5. The improvements to the Survapully river channel

were completed this year at a cost of Rupees 480, and some repairs were also done to the branch channel upon ordinary estimates.

6. The following Statement shews the result of these improvements which at first sight may not appear to be so satisfactory as it really is, for it must be borne in mind, that there was an almost total failure of the North East monsoon in this District, and this was particularly felt in Nellore and its neighbourhood, where no rain fell after the 1st week in October, so that it may be said nearly the whole of the revenue from the undermentioned tanks was derived from the water that passed down this channel from the Pennair.

7. The North East monsoon is what this District chiefly depends on; any failure of its rains must affect the revenue to a greater or less degree. The Talooks however which are irrigated in some measure by the Pennair, suffer of course less than others—and this has been the case this last season.

8. Statement shewing the revenue derived from the tanks depending upon the Survapully river channel for their supply of water.

Years.	1844-45	1845-46	1846-47	1847-48	1848-49
Survapully	3859	3814	4272	3276	4735
Pennoburty	2315	2646	2739	2676	3078
Bramadavum	2544	3957	3304	2567	2885
Annakapully	1650	1564	1627	1401	1808
Total..	10368	11981	11942	9920	12506

9. ANNICUT ACROSS THE KUNDLAIROO.

10. The body of this work is 90 feet long by $4\frac{1}{2}$ wide on the average, and 6 feet high of Laterite stone—standing on a foundation of 8 feet deep and $8\frac{1}{2}$ feet broad on the

average, supported by wing walls of brick in chunam 12 feet high with buttresses, and further strengthened by an apron of rubble stone 33 feet wide, which was secured by a retaining wall sunk 9 feet deep in the bed of the river.

11. This work was commenced in May and completed in July following at a cost of Rupees 3,090, but a temporary embankment that had been thrown across the river, to arrest the progress of any water that might come against it whilst the work was in progress, was not removed, by some inattention on the part of the Talook authorities, though an order to this effect had been given by the Collector on the 17th September—consequently when a fresh came down on the night of the 4th October it destroyed this embankment, carrying the Palmyrah trees, Brushwood &c. with which it was composed, against the dam stones of the Annicut, by which the free passage of the water was stopped, until the accumulated weight of wood, and water overturned 12 of these stones tearing up 40 feet of the body of Annicut to a depth of 3 feet, the depth at which they were fixed. Thus the benefit expected from this work was lost for this season. The injury the Annicut sustained has been repaired without any expense to Government.

13. The works sanctioned by Government during this year amounted to Rupees 40,439 which may be classed as follows :—

2 Estimates for the repair of Revenue Buildings Rs.	636
1 do. for constructing Public	do. 1629
4 Works connected with Irrigation	38173

Total Rupees..40438

14. The first class needs no remark. The work in the 2d class was a Choultry for Native Travellers to be built on the North bank of the Pennair opposite to the town of Nellore, where much inconvenience was always experienced by Native Travellers when the Pennair was full.

15. In the last class, the first estimate amounting to Rupees 6,234 was for building Sluices and Calingulahs &c. to different tanks.

16. The second estimate that was sanctioned was a project for cutting a channel from the Vagoor river channel for the better supply of the villages of Parlapully, Vedavulloor, Choukcocherla, Vauvillah, Durnpoor and Auleganapaudoo in the Talamunchy Talook.

17. The Vagoor channel branches off the North bank of the Pennair and receives more water than the tanks it supplies requires, a large quantity therefore flows in most years over the Calingulahs of the different tanks, and returns to the Pennair; the object of the present undertaking was to direct a portion of this water, to fill the above-mentioned tanks that depend chiefly on local rains.

18. The next work sanctioned by Government was an estimate amounting to Rupees 3,615 for completing the new channel of supply to the Nellore tank. This work was completed this year at a cost of Rupees 2,315 and the following Table shews the results.

Years.	1844-45	1845-46	1846-47	1847-48	1848-49
Revenue ...	10882	20564	21098	12244	18234

19. As this tank fell particularly under my observation, and knowing also the opinion of the ryots of Nellore, I can safely state that if this channel had not been cut, nothing like the revenue that has been collected would have been realized. But whatever proportion of the revenue is assigned to this channel, it cannot be disputed, it has not yet had a fair trial. I shall therefore make further mention of it in my Report for this year, for I feel confident the results will be satisfactory.

20. The annual ordinary estimate for the year amounted to Rupees 26,123 of which Rupees 23,823 were expended upon 253 works. The greater number of these

were individually of small amount and do not require to be particularly alluded to in this Report.

(Signed) A. DEBUITS,
Civil Engineer.

3D DIVISION.

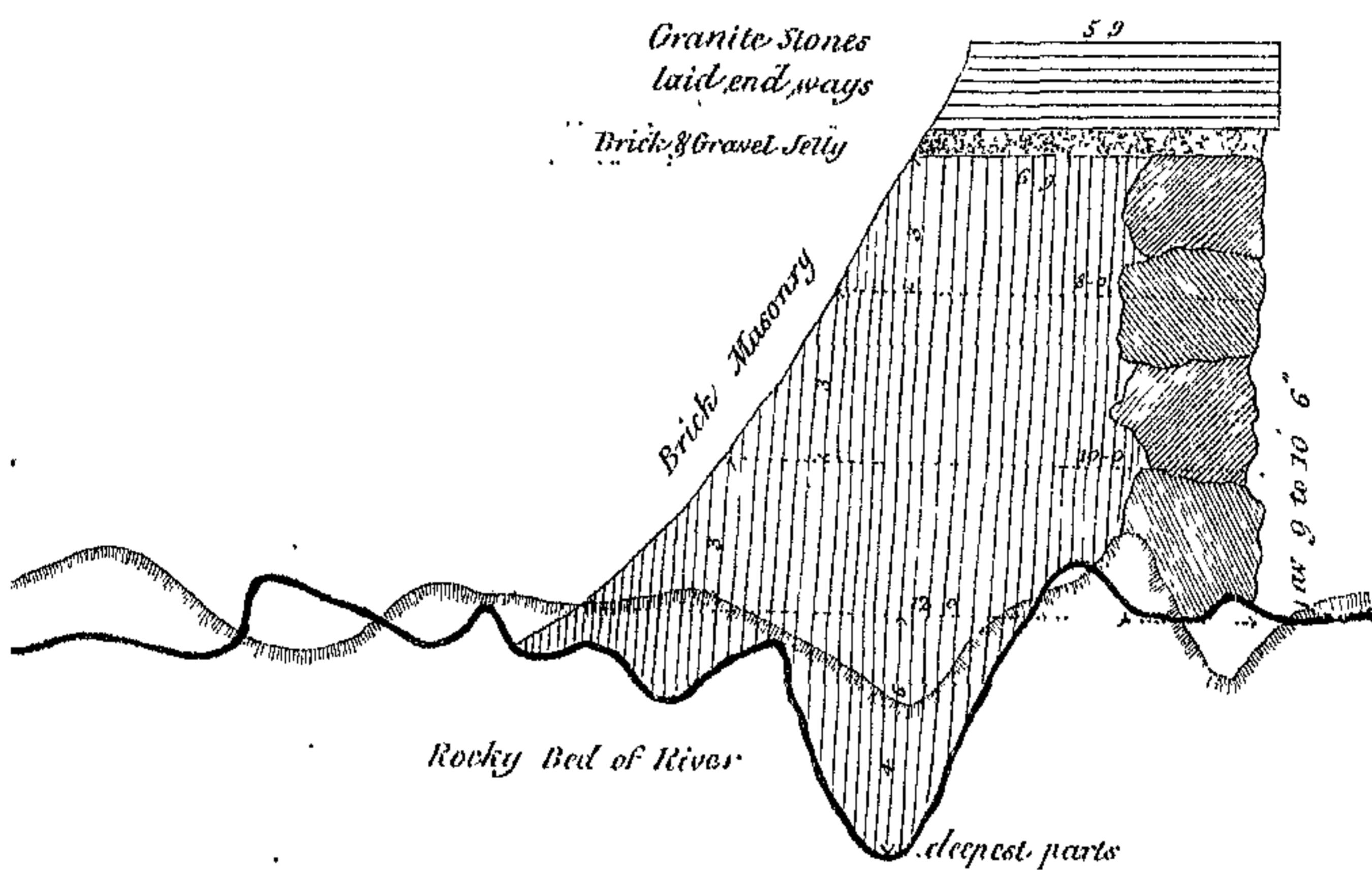
BELLARY 1848-49.

The only important work executed in this District in 1848-49, was the reconstruction of the Wullabapoore Annicut, which is a dam across the Toombudra river situated 44 miles very nearly due West of the town of Bellary.

It is the first, or most Westerly Annicut on the river, and has been rebuilt a short space in rear of the old work, has been made a few inches higher, and instead of being composed of immense blocks of stone, laid together without any cementing matter between them, but with iron cramps here and there inserted, it has been formed in rear of rough hewn stone in chunam, in front of brick masonry, and covered at top with large cut stones carefully laid down and joined together.

The preparation of materials for this work was begun in September 1846, and as soon as the water in the river had fallen sufficiently low towards the latter end of that year and beginning of 1847 the foundations were commenced. A good part was completed in the dry season, and with the exception of a small portion at the North end, where the rocky bed of the river was nearly on a level with the crown of the Annicut, the work was completed by the end of May 1848.

Section of Anicut.



It was afterwards found desirable to carry it over the rocky portion above noticed, and this was done as early as practicable in 1849, since which period only trifling repairs to the plastering, &c. have been executed.

The section of the work is according to the annexed figure, the whole of it being laid on hard rock. The chief executive difficulty was to keep the work free from the sudden freshes, as also from the water above, which, throughout the dry season, stands from 8 to 12 feet above some of the rocks on which the foundations of the work are laid.

(Signed) F. DITMAS, Bt. Capt.
Civil Engineer.

CANARA 1848-49.

1. MUNJERABAD GHAUT AND ROAD.—Length 30 miles.

Estimate Rupees .. 69,689

Amount expended Rupees .. 62,461

This line leads from Munjerabad, in the Mysore country, almost due West, towards Mangalore, via Oopenungady, and was marked out in 1842 and 1843. The work was commenced soon afterwards, and is now nearly completed. One large and several small bridges, as well as a few drains, are yet required to complete the road, and preparations are now being made for carrying on the work as soon as the season will admit.

This line was constructed in lieu of the Bissly Ghaut road, which joins the new line near Oopenungady, and was not considered worth the expenditure of a large sum of money for its reformation.

A few carts have passed up and down the line but owing to the portion of road between Oopenungady and Buntwal being quite impracticable for wheeled carriages there is no great inducement for merchants to bring their carts as far as Oopenungady, whence however there is

tolerable water conveyance throughout the year by the Mangalore river to that port.

The difficulty of procuring the services of a sufficient number of workmen, and of keeping them together on this line has hitherto been considerable, but it is hoped that in two more working seasons, that is by June 1852, the line will have been fully completed with bridges, drains, &c. wherever required.

2. DAVAMUNNY GHAUT AND ROAD.—North Canara.
—Length 30 miles.

Estimate	Rupees..71,729
Amount expended.....	Rupees..42,619

This line leaves the old Sircee and Neelcoond road in the Balaghat of North Canara, about 9 miles from Sircee and passes over the Ghauts at Davamunny a few miles to the North of Neelcoond. It was traced in 1844 and the works have every year since that period been carried forward as vigorously as circumstances would permit. Early in 1848, it was just passable for carriages, but as a number of rivers and nullahs still required bridging, and the road throughout was not completed to its full width, it was not until towards the latter end of the season of 1849-50 that it was much used by the carts conveying cotton from the interior—then numbers of these vehicles, as well as bullocks, were met with at every turn of road.

One large bridge and several of minor importance are still required and the road throughout is in need of general repairs; it is hoped however that before June 1851, the whole of the line will have been completed.

The old line, via Neelcoond, is still much frequented (by bullocks) when the roadway is dry, but the pass is so steep that I have never heard of a single wheeled carriage having attempted it—the balance in hand, remaining to complete the line, would seem to be nearly sufficient for the work. Preparations are now being made for carrying it on as soon as the season will admit.

3. COOOR GHAUT.—Length 5 miles.

Estimate	Rupees..	8,000
Amount expended	Rupees..	8,000

This ghaut is situated nearly midway between the two ghauts above mentioned, viz. those of Munjerabad and Davamunny, and is due West of the ancient city and district of Nugger, and a few miles North of the large and thriving seaport town of Coondapoore. When completed the roads above the ghaut will lead to it from Anantapoore, Shikarpooor and Shemoga, and below, junction lines are in progress from the foot of the ghaut to Coondapoore, a little to the South, and Byndoore, a small port, nearly due West of the ghaut.

The general course of the old line of road has been selected, but almost the whole of it has been remodelled, and though now steeper than the ghauts abovementioned, and not very easily practicable for carts it is considered very easy for bullocks, and horses, and has, I believe, a more gentle slope than any of the Neilgherry passes, the new Segoor one alone excepted, which I believe, it much resembles in that respect. The work was commenced in 1847, and completed in the season of 1848–49, and as only Rupees 8000 have been expended on it, of course very few masonry works of any great size have been built. Temporary wooden structures appear to be in general use across the broad nullahs, and these must hereafter be made permanent, and if much increase in the traffic happens it will be desirable to widen the ghaut.

4. ARBYLE GHAUT, AND LINE OF ROAD FROM YELLAPOORE TO MEERJAN.—Length 45 miles.

Estimate	Rupees..	5,601
Amount expended	Rupees..	3,091

The ghaut portion of this line, which is situated about 20 miles North and West of the Coompta and Sircy road, and nearly parallel with it, was traced and partially worked out in 1848 and 1849.

There are no masonry works on this line, the slope of which is very gentle and easily practicable for bandics, and though the general course of the old road has been adopted, in consequence of some very steep parts, it has been found necessary to remodel nearly the whole of it.

The work is now about to be carried on from between Soonksal and the river Gungawully, to which point it was completed in the end of April 1850, at which period all working parties on the Canara roads discontinue their operations.

A branch line to Ancola (about 15 miles in length) from near Hunggaducoop (vide printed Map) near the Gungawully river is now being surveyed and traced, for the completion of which an estimate will in due time be forwarded for the sanction of Government.

5. MANGALORE AND Agoombey Road.—Length 60 miles.

Estimate	Rupees..	12,700
Amount expended	Rupees..	5,691

This line leads through Goorpoor, Mood Bidderce, Kaikull, Yenna-Nola-Mutt, Candhola, and Somaishwar, which is at the foot of the Agoomby Pass, a ghaunt leading up from Canara to the Southern parts of the Nugger district of Mysore. The pass itself was entirely remade, reformed and made fit for carts, 8 or 9 years ago, and the approach from the South is now being put in order. The course of the old line has generally been selected except where found too steep, or rocky, and at Goorpoor, as well as in one or two other spots, a road has been carried at a gentle slope along the precipitous sides of the valleys it was found necessary to cross.

The general improvement of the line is still being carried forward, and though no masonry works except a few trifling drains have been, or are to be constructed, it is now practicable for carts as far as Yonna-Nolay-Mutt, and

will probably be made so throughout in the course of the next working season.

No great difficulties have to be surmounted, but it is necessary that the progress of the work should be carefully superintended as some rather difficult portions require to be completed, or made, with great care and attention.

6. SIRCY AND DARWAR ROAD BRIDGES.

Estimate	Rupees..	15,724
Amount expended	Rupees..	15,668

These works were required to complete the line of road from Sircy to the Darwar district frontier with substantial masonry bridges, and during the working season of 1849-50 they were all finished.

The span of the largest arch of any of these bridges is feet 42, the size of the Jhendagherry bridge, which was rebuilt in 1848-49, and after having been somewhat strengthened in its wing walls and approaches during the succeeding season seems to have stood, remarkably well.

The other works have arches varying from 10 to 30 feet in width all of which, it is believed, have remained uninjured up to this date.

The road beyond the frontier, under the superintendence of Bombay Officers, and as far as Hooblee, it is hoped, will be nearly completed during the season of 1850-51, so that from the sea coast at Coompta to Darwar itself, the road should be practicable throughout the year for wheeled carriages.

7. CASSERGODE AND SOOLEA ROAD.—Length 29 miles.

Estimate	Rupees..	9,732
Amount expended	Rupees..	1,645

This branch line from the sea coast at Cassergode to Jaulsoor, near Soolea, which is about 12 miles from the foot of the Sumpajee ghaut, was traced some years ago but was only commenced upon in the season of 1849-50. Nearly half the roadwork has been completed, and the

whole, with drains, will probably be so next working season.

No masonry works, with the exception of a few small road tunnels, having been provided for in the sanctioned estimate, all the nullahs, some of which are of considerable size, must be roughly bridged with the junglewood found in the immediate neighbourhood, or the line will be impassable during the monsoon.

Like most of the other lines leading from the coast towards the ghauts a good deal of thick jungle has to be cleared, and many precipitous hills surmounted. The soil throughout, with the exception of about 1 mile, is very favorable, and as only few cases of fever have hitherto prevailed at any season of the year throughout the whole line it is to be hoped that when completed it will prove a valuable line of communication.

8. OOPENUNGADY AND Pootoor JUNCTION ROAD.— Length 8 miles.

Estimate	Rupees..	2,432
Amount expended	Rupees..	1,175

This line was marked out some years ago, but was not put in hand till the season of 1849–50, when it was begun and completed, with the exception of a few cross, and some catch drains.

The estimate not providing for any masonry works, with the exception of a few small road tunnels, the larger nullahs have been bridged in a temporary manner with the trees cut down in their immediate neighbourhood. The soil throughout is favorable.

Owing to the depth of the water at the ferry at Oopenungady, and the rocky bed in other parts, carts will not be able to cross without being unloaded, and this at all seasons of the year, as the ferry boats are mere canoos and not furnished with platforms. If a good jimgar, or other proper ferry boat was provided the case would be other-

wise. I am doubtful whether the traffic on the line will justify this improved arrangement, but until some better method of crossing the river is adopted, or good boats are kept in readiness, I do not think we can expect carts will take advantage of the new line of road.

9. YELLAPOOR AND MOONDAGODE ROAD.—Length 25 miles.

Estimate	Rupees..	4,025
Amount expended	Rupees..	1,269

This line of road has been made to connect the Darwar and Sircy line with the top of the Arbyle ghaut, which is only a couple of miles West of Yellapoor.

It was commenced and very nearly completed in 1849-50 and although no masonry works of any kind were originally sanctioned, owing to the nature of the country and the few nullahs which intersect it, they do not seem to be urgently required. One large nullah, which on the old road it was necessary to cross twice, has now been altogether avoided, and though masonry bridges and drains will doubtless very much improve the line, and facilitate the progress of the traffic it has already secured, it seems unnecessary to build them, though they will not cost very much, till like works are sanctioned for the remainder of the road to the coast, viz. on the Arbyle and Meerjan and Ancola lines.

A dense forest, much frequented by Elephants, prevails for many miles along the road, but these animals shun it during the dry season when of course it is most frequented by traders.

The main obstacle on this line is the large Baidti Nulla, situated about half way, but as a good rocky site for the foundations of a bridge can be obtained close to the new line, it is to be hoped that this work will not remain long unexecuted.

10. YELLAPOOR AND HULLIAUL ROAD.—Length 30 miles.

Estimate Rupees.. 4,625.

This line is required to connect the Northern parts of the Soopah Talook with the head of the Arbyle ghaut, and has merely been partially surveyed and marked out.

The old line generally will be adopted as it is very direct, but having been in use from time immemorial and being, for a great part of the distance, thro' a dense forest, and consequently much obstructed by trees and their roots, it will be desirable, as well as necessary, to make the line, almost entirely afresh.

The work will be commenced in the course of a few days from this date, and will probably be brought to a termination by the end of April 1851, as there are no masonry works on the line and the Northern parts of it are through a very open country.

The main obstacle on this line, as in No. 9 road, is a large nullah which is 10 miles North of Yellapoor, and which is again crossed within 5 miles of Hullial, but as an abundant supply of wood is obtainable in the neighbouring jungles, wooden bridges, or bridges with stone piers and wooden superstructures, may easily be constructed at a moderate cost.

11. HONORE JETTY—North Canara.

Estimate Rupees.. 1,596
Amount expended Rupees.. 1,766

This work was completed in 1848-49. It has been built as a Breakwater to protect the Custom House, and adjoining warehouses from the encroachments of the sea on the North banks of the broad backwater at Honore, and appears to have fully answered the purpose for which it was intended.

A good part of the labor of constructing, and all that of keeping it in repair, has been borne by the convicts,

under the watchful supervision of the Judge, who, having much strengthened and improved the wharf walls to the East of the Jetty, has added much to the security of the Jetty itself. Had it been left to the care of the Native authorities, or not been constantly watched, I have reason to think it would long ago have become merely a long heap of loose stones, which, though possibly equally useful to protect the shore from the encroachments of the sea would not have afforded the excellent landing place and promenade it now does.

Within the last few years the wharf walls, and other conveniences for shipping and landing goods at Honore have been so much improved that I have no hesitation in stating they are far superior to any thing of the kind in existence only a very few years ago at any of the Ports in Malabar and Canara.

A portion of the body, and much of the extreme end of this work rest on rocks visible at low water so that the intermediate parts only require careful attention, for, resting as they now do on the sandy bed of the backwater they are liable, until the sand shall have been well silted up, to be damaged by the waves raised by every heavy gale of wind. The sand is accumulating to the North and West of the work, so that a few years hence it is to be hoped the work will need much less care and attention than it does at present.

12. ROAD FROM THE ROOT OF THE AGOOMBY GHAUT AT SOMAISHWAR TO BUJJAY.—Length 18 miles.

Estimate,.....	Rupees..4,483
Amount expended.....	Rupees..4,479

This has lately been completed for the purpose of connecting the Agoombey ghat with the head of the navigation of the large nullah (The Savourna Nuddy) which runs into the backwater a couple of miles to the South of Bramahwar and about double that distance North of Oodapee. A

good many masonry drains over the smaller, but only temporary wooden bridges over the larger nullahs have yet been built.

The country throughout is generally undulating and open, though flats, and patches of deep jungle occur here and there. When the line is carried out to Oodapee, and Mulpy, (its Port) it is to be hoped that masonry bridges will be sanctioned for the whole line, as the wooden bridges now in use, in consequence of the want of seasoned timber, and the dampness of the climate for many months of the year, are continually requiring repair. I may here mention that estimates for bridges between Somaishwar and Hebbra have been called for and will be prepared with as little delay as possible, but they are also required between Hebbra and Bujjeh.

13. ROAD FROM THE FOOT OF THE AGOOMBY GHAUT AT SOMAISHWAR TO HALANDEE.—Length 15 miles.

Estimate	Rupees..	2,239
Amount expended	Rupees..	2,274

This, like the road from Somaishwar to Bujjeh, vide No. 12, has only lately been completed, and is for the purpose of connecting the foot of the Agoombey ghaut with the head of the navigation of the large nullahs running into the broad backwater immediately East of Coondapoore.

It is also unprovided with masonry works across the larger nullahs over which the road is carried, but as there is only one stream of any size, and the temporary bridge over it, is kept in pretty good order no great hindrance to the traffic seems yet to have been experienced.

The line originally marked out has been much improved since the road was formed, several steep places having been turned, and thereby avoided, so that throughout it is now quite practicable for carts.

(Signed) F. DITMAS, Captain,
Civil Engineer.

4TH DIVISION.

CHINGLEPUT 1849.

Of the works executed in this district during 1849, the most important are an embankment channel and bridge across the Wotairy nullah to divert its waters into the Coum river, to prevent it, as it has hitherto done, overflowing the Perambore lines, near Madras. The work was commenced on contract; but month after month from April till August, the contractor delayed it; till finding he either could not, or would not do his work, it was finished by Government; it has answered the purpose well, and is considered a great boon by persons in Perambore, the embankment is 492 yards long, has been well rammed and turfed, and cost 1,441-11-0.

NORTH ARCOT 1849.

CAUVERYPAUK TANK.—This tank has had very trifling repairs this year, and I mention it as one of the largest entirely artificial tanks in this district; by this I mean that there are no hills, or other rising grounds, by which sometimes a large tank can be formed with small embankments; its bank is $3\frac{1}{2}$ miles in length, revetted throughout (with squared stones in many places) and is 22 feet high in the inside. In taking down a sluice some few years since, an inscription was found on a stone from which it appears that that sluice had been built upwards of 400 years. It was 12 feet below the present bed of the tank shewing an accumulation to that depth. The revenue collected from cultivation for the last 20 years amounts to 804,293, repairs to 97,605,

or 12-2-2 per cent, but as this includes not only rebuilding a very large sluice but the repairs after a hurricane which desolated half the country in 1836, the actual ordinary repairs amount to Rupees 7-11-8 per cent.

GOONAMADEE CALINGULAH.—Cost Rupees 2,516. This work has been built in the supply channel of the Cauvery-pauk tank, at a place where it was continually being breached, it was built under the superintendence of Overseer Cahill and is a satisfactory work. This work was very requisite; the Cauverypauk supply channel is now in good order.

NATAIRY OTAIRY CALINGULAH.—The calingulah was much damaged in 1846, the wings being entirely washed away; the body cracked, as well as the apron much damaged; an estimate was framed for its repair amounting to Rupees 2,060, and subsequently another of 400 Rupees was added; this was reported as inadequate; on opening up the apron it was found to be wretchedly built and a revised estimate necessary; the work has been almost entirely rebuilt, the wing walls of this calingulah are 23 feet from their foundation to the summit and it has been built throughout in a most substantial manner. The apron is entirely of dressed granite, the cost of the work was Rupees 2,069.

CALAVAYE TANK CALINGULAH.—The surplus water from the calingulah of this tank has an overfall of 11 feet. The apron was damaged in 1845, and rebuilt in 1846 on an estimate amounting to Rupees 3,543: in 1847 it was again destroyed, and has been rebuilt in a most substantial manner at a cost of Rupees 1,589; the apron, which is 5 feet thick of solid stone and chunam with a good rear retaining wall is covered with dressed granite.

(Signed) G. COLLYER, Captain,
Acting Civil Engineer 4th Div.

6TH DIVISION.

TANJORE 1848.

IMPROVING THE VUDDAVAUR RIVER IN THE PAUPANASSUM AND MANARGOODY TALOOKS.

Estimate Rupees., 6,403

Total cost..... Rupees., 5,965

The Vuddavaur branches from the Vennaur about ten miles westward of the town of Tanjore, and irrigates an extent of land equal to 7,014 acres, bearing a revenue of 25,969 Rupees.

For a long period the lower part of its course had been much impeded by accumulations of sand brought down by jungle streams, and was altogether so confined and tortuous as to cause serious difficulties to the proper supply of water, on which account it's enlargement, and the cutting of several sharp bends became necessary.

The work was energetically and efficiently executed and the result has been highly favorable, by giving the lands at the extremity of the river an abundant share of its water.

IMPROVING THE NARASINGA CAUVERY RIVER IN THE PUTTACOTTAH TALOOK.

Estimate Rupees.. 2,196

Expenditure..... Rupees.. 2,196

This river is not in the Cauvery Delta, but branches from the Vellaur, a stream rising in Tondiyan's country. It irrigates a great extent of land, principally on Shrotriya tenure, but of which 1,183 acres yield a revenue to Government of 5,102 Rupees.

Owing to severe freshes some years ago throwing much sand into the branch which flows on a high level,

the cultivation had suffered greatly for want of water and the bed was deepened and widened to increase the supply.

The Shrotriymdars and Enamdars contributed their share of the expense, and the amount stated above is the proportion charged to Government.

The work was most efficiently executed and the result is reported to be altogether satisfactory.

BRIDGE OF FIVE OVAL ARCHES OF 30 FEET SPAN OVER THE ARASELAUR RIVER ON THE ROAD FROM MADRAS TO NEGAPATAM *via* MAYAVERAM AND SHEALLY IN THE NUNNELLUM TALOOK.

Estimate Rupees.. 6,595

Total cost Rupees.. 5,632

The foundations and superstructure to the spring of the arches, including the wing walls were constructed in 1847. In 1848, the arches were turned and the entire work excepting the parapet walls was completed.

The foundations are of wells filled in with cubes of brick masonry and resting on sand; the rest of the work is formed of brick in chunam. The roadway is 24 feet wide including the parapets. The execution of this work was favorably reported on.

BRIDGE OF FIVE OVAL ARCHES OF 38 FEET SPAN OVER THE RIVER TRIMULRAJEN ON THE SAME ROAD AND IN THE SAME TALOOK.

Estimate Rupees.. 7,644

Total cost Rupees.. 6,765

This structure was carried on simultaneously with the Araselaur bridge reported above, and resembles that work in all respects, excepting the foundations, which consist of solid blocks of brick work resting on a firm bed of clay. The reports on this work were also favorable.

The effect of these two works has been very beneficial.

BRIDGE OF THREE SEGMENTAL ARCHES OF 24 AND 12 FEET SPAN OVER THE VEERASHOLEN RIVER ON THE ROAD FROM COMBACONUM TO TRANQUEBAR IN THE PARELLUM TALOOK.

Estimate..... Rupees..2,510
 Total cost Rupees..2,217

This work was commenced and completed in 1848. The foundations are of solid brick masonry, and the superstructure is of the same material. The width of roadway including parapets is 24 feet. The reports on the construction were generally favorable.

The utility of this bridge has been very great in facilitating the export of grain from Tranquebar.

TANJORE 1849.

HEAD SLUICE OR THE RIVER SHENBU CAUVERY.

Estimate..... Rupees..3,143
 Total cost Rupees..3,106

The Shembu Cauvery branches from the left bank of the Vennaur about four miles Westward of the town of Tanjore, and irrigates 3,993 acres of land yielding a revenue of 25,795 Rupees.

For several years the head had been much enlarged, and the flow of water into this branch had been excessive, causing much injury to the dikes, and also to the crops by inundation.

To regulate the supply of water, it was proposed to build at the river head a sluice, consisting of 5 vents each 6 feet wide, divided by piers 7 feet high, flanked by ample wing walls, and secured by broad aprons in front and rear. The piers are faced with cut granite, and the aprons covered with that material. The foundations and mass of the superstructure are of brick in chunam.

The vents can be closed, when necessary by long balks fitting into cross stones laid across the arches,

The work was commenced and completed within four months, and was in all respects favorably reported on. Its effect in restraining the supply of the Shembu Cauvery during floods has been very beneficial.

IMPROVEMENT OF THE MERCALCUNRAY RIVER.

Estimate..... Rupees.. 9,500

Total cost Rupees.. 8,398

The Mercalcunray is a stream in the South part of the Cauvery Delta carrying off the drainage of 15,074 acres of irrigated land bearing a revenue of 53,476 Rupees. It had never been fully embanked, but overflowed the lands lying to the West of its channel, and the cultivation in that direction suffered great injury during excessive rains for want of a free outlet for its surplus water. It was therefore determined to widen and deepen the bed of the Mercalcunray, and form a dike along its right or Western margin, also to open a new and direct course for the river to the great swamp into which it disembogues.

The works were commenced in 1846 and executed gradually during that and the two following years. The improvement was effectual, and has had the best result in relieving the tract affected by it from the inundations to which it was formerly liable.

IMPROVEMENT OF THE VALAVANAU RIVER.

Estimate Rupees.. 7,243

Expenditure' Rupees.. 3,672

The Valavanaur is another great draining channel of the Tritrapoondy Talook, and discharges the surplus water from 12,641 acres of irrigated land bearing revenue of 42,609 Rupees into the great Southern swamp lying between Point Calimere and Adrampatam. This river had never been embanked at all, and its bed being scarcely lower than the surrounding fields, the lands were exposed to constant inundation and the crops to destruction.

To remedy these evils the estimate above stated was

framed for deepening and embanking the channel, and cutting a new and direct course for its discharge into the swamp; of which works only the latter part was executed in 1849, and the remainder was necessarily delayed till the following season.

The part completed in 1849 was very efficiently performed.

BRIDGE OF FIVE SEGMENTAL ARCHES OF 32 FEET SPAN OVER THE RIVER CORAYAUR ON THE ROAD BETWEEN TRITRAPOONDY AND MOOTOOPETTAH IN THE TRITRAPOONDY TALOOK.

Estimate	Rupees.. 6,400
Total cost	Rupees.. 6,341

This bridge was designed to facilitate the export of grain from Tritrapoondy Talook by the sea port of Mootoopeettah on the Southern coast. The work was commenced and completed in one season. The foundations are of solid brick in chunam resting on firm clay and the rest of the structure is of brick masonry. The width of roadway including parapets is 24 feet.

The execution of the work was in all respects most satisfactory, and the bridge has proved a valuable addition to the means of communication in a part of the district, where, until recently, hardly a road could be said to exist, and where traffic was almost precluded for half the year.

BRIDGE OF THREE SEGMENTAL ARCHES OF 35 AND 30 FEET SPAN, OVER THE RIVER CUDDAVELLAUR ON THE ROAD FROM NEGAPATAM TO POINT CALIMERE IN THE KEEVALORE TALOOK.

Estimate	Rupees.. 7,687
Total cost	Rupees.. 7,530

This bridge across a tidal river was proposed in order to connect the villages South of Negapatam with that flourishing port, as well as to facilitate the communication with Ceylon, by the coast road.

The foundations were laid in 1848, and consist of solid brick masonry resting on clay. The piers to the springs were also built in that year of brick in chunam, faced with cut granite brought from Trichinopoly; an excess of expense occurred in sinking the foundations, owing to the springs of water proving more abundant than was expected, and to a deficiency of labour.

In 1849 the arches were turned; the bridge was finished in a satisfactory manner, and has proved a most important improvement.

BRIDGE OF FIVE SEGMENTAL ARCHES OF 38, 35 AND 32 FEET SPAN OVER THE NUNDALAUR RIVER ON THE ROAD BETWEEN TRANQUEBAR AND NEGAPATAM IN THE TRANQUEBAR TALOOK.

Estimate.....	Rupees..	10,631
Total cost.....	Rupees..	10,179

Since the acquisition by the British Government of the Tranquebar territory, the communication between that town and the ports to the Southward of it has greatly increased, and a bridge over the Nundalaur, about two miles from Tranquebar, and within tidal limits became most desirable.

The foundations were laid in 1849, and were built of solid brick masonry, the piers were also raised with brick in chunam faced with hewn granite, and the entire superstructure was finished in the same year, the operations having occupied altogether about five months. The roadway is 24 feet wide including parapets.

The construction of this bridge was conducted with the utmost vigour and efficiency and its completion has conduced greatly to the comfort of a large trading population.

BRIDGE OF FIVE SEGMENTAL ARCHES OF 30 FEET SPAN OVER THE RIVER TRIMULRAJEN ON THE ROAD FROM COMBAONUM TO NEGAPATAM IN THE VELUNGAMAN TALOOK.

Estimate.....	Rupees..	6,458
Total cost.....	Rupees..	5,292

This bridge was intended to open the communication between the very large town of Combaconum and the chief seaport of the province.

The foundations consisted of solid brick masonry, the piers and arches of the same material, and the entire work was completed within five months in a perfectly satisfactory manner. The width of roadway is 24 feet including parapets.

BRIDGE OF THREE SEGMENTAL ARCHES OF 36 FEET SPAN OVER THE RIVER MOODECONDAUN ON THE SAME ROAD AND IN THE SAME TALOOK.

Estimate	Rupees.. 4,584
Total cost	Rupees.. 3,841

This bridge was built at the same time as the foregoing one, and is of similar construction excepting that it is partly founded on wells.

The execution of the work was altogether satisfactory.

BRIDGE OF THREE SEGMENTAL ARCHES OF 30 FEET SPAN OVER THE RIVER POOTAURO ON THE SAME ROAD IN THE CODAVASSEL TALOOK.

Estimate	Rupees.. 3,944
Total cost	Rupces.. 3,936

This bridge is similar in all respects to the above, was executed at the same time and in a manner equally satisfactory, and it only remains to observe that the advantages resulting from the construction of the three bridges are fully appreciated by the traders and land holders along this important line.

BRIDGE OF FIVE OVAL ARCHES OF 30 FEET SPAN OVER THE RIVER PAUMANY ON THE ROAD FROM COMBACONUM TO MANARGOODY IN THE MANARGOODY TALOOK.

Estimate	Rupees.. 6,286
Total cost	Rupees.. 5,842

To complete the communication between these two very large towns was the object of this work.

The foundations of solid brick masonry were laid in 1849, and the piers and arches of similar material were finished in about five months in a style of great efficiency, and the work proves of the utmost convenience to the people, and being on one of the salt roads, subserves materially the interests of Government.

BEACON COLUMN AT POINT CALIMERE.

Estimate	Rupees..	2,753
Total cost.....	Rupees..	2,733

The low coast about Point Calimere being very difficult of recognition by the vessels trading between the continental ports and Ceylon, a beacon was proposed to distinguish this important position where the shoals render navigation peculiarly unsafe.

The structure consists of a plain doric shaft 60 feet. high, including its base, but hollow, in order to be converted, if necessary, into a Light House.

The foundations are of wells and the material is brick in chunam, carefully plastered with a fine white surface. The base is faced with stone to a height of 3 feet to secure it from the action of salt.

The foundations and base were constructed in 1848, and the pillar in the following year, and the work was executed in the most efficient manner, under circumstances of unusual difficulty in regard to material.

It is stated by the Native traders of Negapatam that the value of this land-mark is duly appreciated.

BEACH DEFENCES AT TRANQUEBAR.

Estimate	Rupees..	5,155
Total cost.....	Rupees..	5,058

The encroachments of the sea on the town of Tranquebar had long excited the fears of the inhabitants, and soon after the transfer of the place to the British Government, some attempts were made to prevent further inroads, but with small success. In 1848 an estimate was framed

for protecting the beach by a line of piling and plank work, and for constructing short groins, and the works were executed partly in that year and partly in 1849, but owing to the nature of the material they suffered extensive injury in the monsoon of that year, and operations of a more solid and expensive nature became necessary. The works were carefully and efficiently performed.

IMPROVING THE PORT OF NEGAPATAM.

Estimate	Rupees..	9,500
Total expenditure	Rupees..	9,009

The river Cuddaveyaur which disembogues into the sea at Negapatam, had for a long period discharged the main body of its waters through the Vellayaur at Velangunny, four miles to the South, and the loss of this stream had caused the Negapatam bar to be almost impassable for the smallest vessels.

The works included in this report were commenced in 1846, and consisted of the excavation of a new channel for the Cuddaveyaur, to bring its whole volume of water to the sea at Negapatam, and the construction of a small and rude Jetty, to restrain the mouth of the river and facilitate the shipment and landing of goods.

The works of 1849 were almost entirely confined to the construction of the Jotty ; they were efficiently executed and the result of the whole project has been a decided improvement in the state of the port which has materially benefited its trade.

At the same time it should be recorded that further improvements are manifestly very desirable and quite practicable.

TRICHINOPOLY 1848.

IMPROVING PART OF THE WEYACONDAUN CHANNEL.

Estimate	Rupees..	9,191
Expenditure.....	Rupees..	8,967

The Weyacondaun channel is led off from the river Cauvery at about sixteen miles Westward of Trichinopoly, and flows for a distance, including sinuosities, of $17\frac{1}{2}$ miles Eastward of that town. Its bed had long been very much filled up with mud, and in its lower course was too narrow for the volume of water required to irrigate the tract of 9,281 acres, yielding a revenue of 56,831 Rupees, which is the extent dependent on this part of the channel.

The estimate provided for deepening and widening the channel for a distance of $17\frac{1}{2}$ miles, which was effectually performed, to the great advantage of the lands influenced by it, which have since been abundantly supplied with water.

REBUILDING DARK'S BRIDGE ACROSS THE WEYACONDAUN CHANNEL AT TRICHINOPOLY.

Estimate	Rupees..	3,110
Expenditure.....	Rupees..	2,656

The Weyacondaun channel was crossed near the town of Trichinopoly by an ancient Native bridge, or rather causeway, with seven vents, each of 5½ feet span, and this work caused great obstruction to the free flow of the water, and was most injurious to the cultivation dependent on the channel Eastward of the town.

To remove this evil the work was demolished, and a bridge was constructed of three segmental arches of 27 and 26 feet span. The piers are built on the old foundations of stone, but the arches and superstructure are of brick masonry. The width of roadway is 40 feet. The work was effectually executed and the effect on the channel has been highly beneficial.

EXTENDING THE COVELLAY SURPLUS CHANNEL.

Estimate Rupees..2,990

Expenditure (including 1849). Rupees..2,718

The drainage of 1,455 acres of irrigated land, yielding a revenue of 7,692 Rupees, being much impeded by the high level at which it was discharged through the Covellay channel into the Vennaur river, it was determined to prolong the channel, and fix its outlet about a mile and a half, lower down the river, by which a fall of nearly 4 feet would be gained. At the same time it was necessary to construct a dam across the surplus channel in order that its waters might when necessary be made available for the irrigation of the lands of Killioor still further to the Eastward.

The excavation of the channel was partly performed in 1848, and was attended with much difficulty from the rocky nature of the soil ; the Calingulah or dam was built in 1849 and the channel also completed, and the works were in general well executed. The drainage has been greatly improved by the alteration.

IMPROVING THE NADOKURRAY MAIN CHANNEL.

Estimate Rupees.,9,258

Expenditure..... Rupees..8,701

This channel, branching from the Cauvery on its North side, irrigates the island of Seringam ; it had no head sluice, and was in consequence very liable to be over supplied from the river, and its banks near the head were frequently breached.

Two smaller channels, one at Mailoor, branching from the same side of the Cauvery, the other at Vellitoraymootum, issuing from the South side of the Coleroon, watered smaller portions of the same tract between the two rivers, and the supply of these channels was likewise attended with considerable difficulties.

It was determined to extend the head of the main channel $3\frac{1}{2}$ miles higher up the course of the Cauvery, and

there build a head sluice for regulating the supply, and to carry the secondary channels from the same source by sluices in the main channel.

The main sluice is a work of four vents of 5 feet each, protected by ample wing walls, and secured by front and rear aprons. The foundations rest on wells, and the structure is built of brick in chunam, the piers being faced with cut stone. It is regulated by balks placed within the cross stones extending between the piers.

The secondary sluices are on the same principle, and of similar construction, though much smaller.

The masonry and earthworks were efficiently executed in about four months.

The advantages expected from these improvements have been only partially realized in consequence of the banks of the channel having been damaged by the river freshes below the point to which the works extended, but there can be no doubt that the wet cultivation of the Sein-gam island extending over 4,021 acres with a revenue of 23,273 Rupees, will in future be materially benefitted by the power now gained of regulating its supply of water.

EXTENDING THE RETTENAGOODY ANNICUT AND WIDENING THE NUTTUD NULLAH CHANNEL.

Estimate	Rupees..	11,278
Expenditure.....	Rupees..	10,948

The Rettenagoody Annicut is a work of Native construction, which serves to carry the Peravully channel (issuing from the Cauvery 24 miles to the Westward) across the Oopaur, a large and violent torrent which rises in the neighbouring hills.

Beyond the Oopaur the channel loses its name, and is called the Nuttud nullah, and this, after a course of ten miles, in which it irrigates a large extent of land, finally terminates in the Shengundy tank.

The Rettenagoody Annicut was much too confined for the safe discharge of the vast flood that occasionally poured over it, and the Nuttud nullah was so narrow as not to afford a free course to the water required for the extensive tract under irrigation, in consequence of which it was resolved to lengthen the Annicut, and widen the channel.

The addition to the Annicut is a solid brick in chunam wall 11 feet high, 12 feet thick at the base and 4 at the crown, and 108 feet long, secured by an apron of cut stone 40 feet wide, and a wing wall of ample dimensions.

The work was somewhat protracted in execution, but was satisfactorily finished.

The excavations of the channel were efficiently performed, and the general result of the combined works has been to afford an unfailing supply of water to the remotest of the lands dependent on this channel.

IMPROVING THE ROAD FROM TRICHINOPOLY TOWARDS COIMBATTOOR ALONG THE RIGHT BANK OF THE CAUVERY.

Two Estimates Rupees 7,695 and Rs. 988

Total expenditure including 1849 Rs. 8,683

This ancient line of road had never been available for traffic except in the hot weather, being at other seasons rendered impassable by numerous irrigating and draining channels issuing from, or falling into the great river, along the bank of which it runs. Numerous villages, fine topes of trees and shady avenues render it otherwise a most desirable line of communication, through a tract similar in fertility and populousness to the best parts of the Delta, while the route in actual use along the high ground traversed a poor, desolate country, with hardly any advantages, though not being intersected by any of the Cauvery channels, it was more constantly passable.

It was considered desirable to open the lower or river road, by constructing small bridges over the numerous

channels, and raising such parts of the line as were liable to inundation.

The improvements were commenced in 1847 and continued till 1849 and though slowly, were in general satisfactorily performed.

The chief masonry works consisted of a bridge of one arch of 18 feet span across the Kistnarayapoorum irrigating channel, another of one arch of 12 feet span across the Chintelwady surplus channel, a bridge of 3 arches of 10 feet span across the Pillapoliam surplus, and one arch of 12 feet across the irrigating channel of the same village. A bridge of one arch of 18 feet across the Murdoor channel near Wuddium, another of 14 feet over the same channel near Kootitullay. A bridge of two arches of 11 feet across the Nunga Voikal (irrigating channel) and one of two arches of 18 feet across a surplus stream from the same channel.

Besides the above the roadway of the great head-sluice of the Weyacondaun channel was widened by $31\frac{1}{2}$ feet by the construction of 3 arches of 12 feet average span. A bridge of 2 arches of 9 feet across the Iyen Voikal irrigating channel and additions to the roadway of the head sluices of the Ramavoitullay, Yellundavoitullay and two other channels, formed the remaining works, besides which 24 road tunnels of various dimensions were constructed.

The soil being almost all alluvial, the road consisted only of clay overlaid with sand, as is usual in all the Delta roads, but for the most part it is in tolerable condition for cart traffic throughout the year, though some portions are still too low.

The distance included in this general improvement is altogether 38 miles, and the great amount of the traffic along the road is a striking proof of its importance, not only to Trichinopoly and Coimbatoor, but to numerous villages which previously had no means of communication by wheeled conveyances in any direction.

JAIL AT TRICHINOPOLY.

Estimate	Rupees..	20,975
Deduct Convicts' labour.....		5,000
		15,975
Cost.....		14,441

Executed by the Civil Engineer's Department.

The old Jail situated in the town of Trichinopoly, had long been considered inadequate in space, and very defective in internal arrangement.

The new building is situated on the old esplanade, a very open spot on the South side of the town, and is calculated for 500 prisoners including sick.

The buildings are arranged in a double row with a central passage 50 feet wide, and consist of double tiled sheds, divided by pillars and a connecting wall, the breadth of each half building is 8 feet and the length 75 feet. Each half shed is intended for 25 prisoners, and between each there is a yard 20 feet wide, which opens only into the central passage or yard. Consequently each class of prisoners has a distinct lock-up ward and a yard attached to it. The larger classes are sub-divided into two at night.

In the main Jail there are six classes of 50, or at night twelve of 25, and four of 25 men each, and at one end of each row is a cooking shed 75 feet long ; at the other end is a similar shed for peons, stores, &c. divided by cross walls, with two rooms for solitary confinement. The front of the prison-sheds is closed by a wall 3 feet high, above which are iron bars fixed in frames, on which the eaves of the roof rest, so that the air may find free access along the entire length of the building, and as the wall connecting the main pillars is 5 feet lower than the ridge of the roof, the sheds are thoroughly ventilated, but the fronts are provided with shutters, which can be closed when necessary.

In another enclosure adjoining, but quite distinct from the main Jail, are the hospital and the civil and female

wards, the two latter being also entirely separate from the hospital, and from each other, though the entrance to these three divisions is by one guardroom distinct from the main Jail gateway. The civil and female wards are on the same plan as the wards in the main Jail, and will ordinarily contain 30 inmates each, but might easily accommodate more. They have large yards, in which are cooking sheds and sick wards, so that under no circumstances is it necessary to bring these two classes into contact with any others.

The hospital is a building 65 feet long, and 18 feet wide surrounded by a verandah, and divided into two wards. It is provided with a surgery, and all other requisite out offices, and in the yard are two lunatic cells. The walls of the hospital are 16 feet high with ventilators above all the windows, and it is very airy.

The entire Jail is surrounded by a boundary wall 15 feet high, and the principal gate opens through a guardroom, with a store room on one side of it. Four watch towers are built on the boundary wall.

The drainage is complete, and a supply of water from a large well in the main Jail is daily carried through every yard.

It is intended to form an enclosure at the back of the Jail to contain worksheds, &c.

The masonry work of the Jail consists in great measure of the stone of the old Fort, that in the foundations laid in clay, but the superstructure excepting part of the boundary wall is built entirely with stone or brick in chunam. The roof timber is almost all Jaffna palmira of the best quality, and the material of the doors, windows and other woodwork is teak. The floors of all the buildings are of clay except the hospital, which has a cut stone floor. The height of the floors above the ground level averages 1½ foot and the soil is hard gravel.

Convicts were employed as much as possible in the

construction and the full estimated value of their labour was realized.

The Jail has been very favorably reported on by the Judicial and Medical Officers of the Station.

TRICHINOPOLY 1849.

IMPROVING THE WEYACONDAUN CHANNEL.

Estimate	Rupees..	4,899
Expenditure.....	Rupees..	4,781

In the Report of 1848 it is stated that a part of this great channel $17\frac{1}{2}$ miles in length Eastward of Trichinopoly was widened and deepened. In 1849, the improvement was continued up the watercourse for $10\frac{1}{2}$ miles as far as the Poolivellum sluices of discharge.

The works were similar in character to those already reported and were vigorously performed by the Revenue Department during the short period available for such operations, and the result is unquestionably satisfactory, not only in the increased volume of water delivered through the channel, but in the much greater security of the banks during heavy floods.

IMPROVING THE PERAVULLY CHANNEL IN LAULGOODY TALOOK.

Estimate	Rupees..	5,113
Expenditure.....	Rupees..	4,604

The Peravully channel branches from the North side of the Cauvery, just above the Upper Coleroon Annicut and its main stream irrigates 9,737 acres, yielding 54,552 Rupees.

For a long period no efficient repairs had been performed to it and its bed was choked with mud, its banks weakened and decayed.

The works now under report were for the purpose of clearing the bed, and strengthening the banks of this great channel for about fifteen miles, and were efficiently performed to the great advantage of the lands under the channel which had previously been liable to frequent failure of their supply of water, partly because the banks were too weak to bear a full supply and partly owing to the want of capacity in the bed.

IMPROVING THE PUNGOONY CHANNEL.

Estimate	Rupees..	2,581
Expenditure.....	Rupees..	2,535

The Pungoony channel is a branch of the Peravully above noticed, but flows on a lower level, and acts both as a draining and irrigating channel. The land dependent on it is 6,201 acres, producing a revenue of 32,182 Rupees.

For a long period this channel had not been much attended to, and its influence both on the drainage and the irrigation of its proper tract had declined, in consequence of which it was effectually repaired both by widening and deepening in 1849, and the result has been a great improvement in the state of the cultivation affected by it.

IMPROVING THE VITTIUTTY MAIN CHANNEL IN VITTIUTTY TALOOK.

Estimate	Rupees..	2,424
Expenditure	Rupees..	2,077

The Vitticutty Talook lies along the right bank of the Cauvery from about 16 miles Westward of Trichinopoly as far as the boundary of Coimbatoor about 24 miles further up the river. The irrigated land is a comparatively narrow strip about a mile and a half in width, but its means of supply are abundant. For some years however the revenue had declined, and it was evident that the lands situated at the Eastern extremity of the Talook did not receive their due share of water from the main channel on which depend 7,016 acres yielding a revenue of 52,950 Rupees.

To overcome the difficulties complained of, it was proposed to cut a new branch channel or feeder from the Cauvery for the lower villages, and to widen and embank the main channel for part of its course 9,000 yards in length, where it was much too narrow, and was also exposed to the inundations of the river, by which its bed was filled with mud. Also it was planned to enlarge the waterway of an old sluice across the channel about midway in its course, and to construct a new sluice at its actual head in the Cauvery.

These works were executed in 1847, and the two following years, in a manner generally satisfactory.

The new sluice has two vents of 5 feet each in width and the same in height. It is protected by ample wing walls, and the foundations, which are of solid brick masonry, are secured by aprons in front and rear.

The effect of these improvements on the supply of water throughout the course of the channel has been very beneficial.

BRIDGE OF 32 ELLIPTIC ARCHES OF 49 FEET SPAN ACROSS THE RIVER CAUVERY AT TRICHINOPOLY.

Original estimate.....	Rupees..	71,010
Supplemental estimate	Rupees..	28,136
Expenditure	Rupees..	97,414

Executed by the Collector's and Civil Engineer's Departments.

Since the year 1835 the want of a bridge over the Cauvery at Trichinopoly had been urged by the Collector, and the work was finally sanctioned in December 1845, and commenced in February 1846. By the month of May the foundations, and piers to the spring of the arch had been finished, and operations ceased for that year.

In January 1847 the centerings were commenced, and several of the arches were in progress, when on the

17th February, the work was stopped and damaged by a sudden and unprecedented fresh in the river. Operations were resumed in March, and considerable progress had been made by the middle of April, when a violent storm which prevailed along the Western Coast, and throughout the basin of the Cauvery, caused the river to fill as it usually does only in July, and the flood destroyed all but six of the arches, some completed, and others in various stages of progress.

In 1848 two arches were rebuilt and the finished work (comprising eight arches) secured by a fixed centering under the last arch.

In 1849 the remaining 24 arches and superstructure were completed, and the bridge was opened for use.

The foundations of this bridge are on wells sunk 9 feet below the bed, which is sand. The piers are $7\frac{1}{2}$ feet average thickness, and $8\frac{1}{2}$ feet high; the rise of the arch is $12\frac{1}{2}$ feet, and span 49 feet. The width of roadway including parapets (which are one foot thick) is 27 feet and the total length from wing to wing is 1,882 feet or rather more than a third of a mile. The material throughout is brick in chunam.

The utility of this bridge will appear from the following statement of the daily traffic over it on an average of three days.

Average daily traffic on the Cauvery bridge at Trichinopoly in October 1850.

Foot passengers.....	9,061
Carts and carriages	223
Bullocks and cows.....	484
Horses	20

CONSTRUCTING A NEW ROAD FROM TRICHINOPOLY TO TOWAGOODY, THE FIRST STAGE TO TANJORE.

Estimate.....	Rupees..	23,038
Expenditure	Rupees..	17,578
Executed by the Civil Engineer's Department.		

The old line of road from Trichinopoly to Tanjore took a very circuitous direction in the first stage, and was altogether in extremely bad order ; it was therefore proposed to form an entirely new and direct road, three miles shorter, and the route adopted was one which had been anciently used in the dry season, though quite impassable for six months in every year.

A considerable extent of the land to be traversed is under irrigation, and the Weyacandaun channel crosses the line three times, besides other unfordable irrigating and draining streams.

Operations commenced in April 1849, and by the end of the year the following masonry works had been constructed on the new road ; two bridges each of 3 arches of 26 feet span across the Weyacandaun, another bridge of 3 arches of 20 feet over the same channel, a bridge of 3 arches of 16 feet across the Covelly surplus channel, a bridge of 3 arches of 12 feet over the Killy Voikal (irrigating channel), a single arch of 24 feet span over the Retta Voikal, an arch of 12 feet over the Tadenvyal surplus channel, besides 27 tunnels of various dimensions from 1½ to 8 feet span.

The length of road raised and gravelled through paddy fields is 3 miles, and that formed through dry lands is 6 miles.

The entire road was not completed in 1849, but was opened and used, and its advantages consist not merely in forming a good communication from Trichinopoly towards Tanjore and Negapatam, but in facilitating the access to many villages surrounded by wet cultivation, and water-courses which previously cut them off from the great local market for their produce.

CONSTRUCTING PART OF ROAD FROM TRICHINOPOLY TO
ARREALOOR.

Estimate Rupees.. 13,862
 Expenditure Rupees.. 2,188

Executed by the Civil Engineer's Department.

The road from Trichinopoly to the Arrealoor Talook on the North of the Coleroon runs through the large trading town of Poovaloor, which is situated between the Coolyaur and Pungoony, the former a large and violent jungle river, which is often flooded and is very dangerous, and the latter a large channel from the Cauvery.

The portion of road included in this report extends for $1\frac{1}{8}$ mile across a sheet of irrigated land, and the masonry works include a bridge of five arches across the Coolyaur and one of three arches over the Pungoony.

In 1849 the earthwork of the road was finished and covered with a coating of sand. 7 tunnels and 3 small bridges of various dimensions were also built, but of the two larger bridges nothing was done except the preparation of materials.

IMPROVING THE ROAD FROM TRICHINOPOLY TO LAUL-GOODY.

Estimate Rupees.. 5,203
 Expenditure Rupees.. 1,347

Executed by the Civil Engineer's Department.

This road extends for ten miles through one of the richest tracts of irrigated land in the district, and being quite neglected for a very long period and unprovided with any bridges or tunnels it was impassable for carts.

The present improvements consist of raising low inundated parts, building 8 tunnels and 3 bridges, but in 1849 only the earthwork and the preparation of materials for the masonry works were accomplished. The soil is alluvial throughout, and no metal being procurable, the usual and

tolerably efficient substitute of sand was laid on the surface of clay.

TALOOKS OF CHELLUMBRUM AND MANARGOODY IN SOUTH ARCOT 1848-49. WIDENING THE VUDDAVAUR RIVER AND FORMING A DIKE ON ITS LEFT BANK IN MANARGOODY TALOOK.

Estimate	Rupees..	3,056
Expenditure.....	Rupees..	3,050

The Vuddavaur, branching from the Coleroon just above the lower Annicut, supplies the great Veeranum tank, and irrigates directly or indirectly about 40,000 acres of land yielding a revenue of 200,000 Rupees.

Part of its channel had been widened and embanked in 1841, but for a considerable distance it was left in a state too narrow for the extensive tract of irrigation it is required to supply. Moreover the lands on its border were liable to inundation by its waters during high freshes, and loss of revenue had from this cause been sustained, in consequence of which the work under report was sanctioned.

The channel was considerably widened for a distance of $3\frac{3}{4}$ miles and the excavated soil was thrown up as a dike, and the result has been the resumption of cultivation on 85 acres of land previously abandoned, and the far more abundant supply of water to the irrigated tract.

REPAIRING THE BANKS OF THE COLE ROON RIVER IN THE LIMITS OF GOONDELA PAUDY, IN CHELLUMBRUM TALOOK.

Estimate.....	Rupees..	3,284
Expenditure.....	Rupees..	3,230

The river Coleroon divides into two branches a short distance below the ferry on the road from Madras to Tanjore, and for some years past the Northern branch had become deeper and wider, while the Southern arm had been greatly filled up with sand. The island between these two streams, which belongs to South Arcot, is three miles

in length, containing several villages, and there can be little doubt that it was formed by the river breaching its Northern bank, though no records of such a catastrophe exist.

In consequence of the great draught of the Northern arm, the current had acted with most extensive and injurious effect on the irrigated lands of Kautoor, situated on the Northern side of the river, and there can be little doubt that if left to nature, the result would have been the further division of the stream, and formation of another island, for such is the tendency of all deltoid rivers.

It was therefore necessary to lose no time in checking the progress of encroachment, and forcing back a due proportion of the current into the Southern branch, for which purpose an embankment, 400 yards in length, was thrown across the Northern stream at the point of separation, or *head of the island*.

It was not expected that this bund would resist the extreme freshes of the Coleroon, but the object was that it should stand long enough to divert a considerable body of water into the desired channel, and thus clear out the sand by which it was obstructed, for which purpose excavation of the bed would not suffice, as the high winds which prevail just before the freshes set in, would rapidly throw back the sand removed by such means.

The embankment remained firm until the extreme freshes in July when (as expected) it was breached, after having had the most decided effect in relieving the Northern branch of its excessive volume of water, and restoring the proportions of the two streams, but the operations could not be considered final.

The embankment was very well constructed, 400 yards in length 5 yards in height with ample slopes, revetted with facing work, and durbah grass,

IMPROVING THE ROAD BETWEEN MANARGOODY AND
CHELLUMBRUM.

Estimate	Rupees..	5,981
Expenditure	Rupees..	4,896

The communication between the two principal towns of these Talooks lying across an alluvial plain, subject in many places to inundation, was impracticable for all wheel-ed carriages, and very difficult even for bullocks. Part of the line near Chellumbrum was raised and formed in 1847 and 1848, and the present estimate was sanctioned for completing the road as far as Laulpett.

The road is formed of the natural soil raised about one yard above the level of the plain, and covered with a coating of sand. The total distance formed under this estimate is $12\frac{1}{2}$ miles in both Talooks. There are 16 masonry tunnels of various sizes from 1 to 3 feet.

This report includes a small amount of work executed in 1850, chiefly in repairs but on the same estimate.

The works were favorably reported on, and the advantages of this new line of road across such a difficult country are fully appreciated by the inhabitants.

IMPROVING ROAD FROM LAULPETT, THROUGH MANARGOODY TO WOMAMPILLOOR IN MANARGOODY TALOOK.

Estimate.....	Rupees..	2,799
Expenditure.....	Rupees..	2,717

This road leads to the Coleroon river, and is a much frequented route between the districts of Tanjore and South Arcot.

The works performed on this estimate consisted of raising and forming the road for a distance of six miles and constructing seven tunnels of 3 feet span, and were in general satisfactory.

The value of the improvement has been acknowledged by the neighbouring landholders.

BRIDGE OF ONE SEGMENTAL ARCH OF 40 FEET SPAN
ACROSS KHANSAIB'S CHANNEL ON THE ROAD BETWEEN MA-
NARGOODY AND CHELLUMBRUM.

Two Estimates Rupees 1,825 and Rs. 1,419
Expenditure Rupees.. 3,233

The Khansaib's channel, a deep and muddy stream, crossing the line of communication twice between Manargoody and Chellumbrum, two bridges were sanctioned in 1846, and one at Madapoorum was completed in 1848. The other at Comaratchy, now under report, suffered injury from an extensive flood in 1847, while unfinished, and it was found necessary to enlarge the waterway. This work was accordingly commenced and completed in 1849, in a very satisfactory manner. The foundations are of solid brick masonry resting on firm clay; the superstructure is of the same material. The breadth of the roadway is 19 feet including parapets. The work was completed in about five months.

The facility afforded by this bridge to the traffic across these rich alluvial lands has been very great.

BRIDGE OF THREE ELLIPTIC ARCHES OF 49 FEET SPAN
ACROSS THE NUNDIMUNGALUM OOPENAUR RIVER ON THE
ROAD BETWEEN CHELLUMBRUM AND SHEALLY.

Two estimates Rupees 10,200 and Rs. 5,970
Expenditure Rupees.. 16,077

The Nundimungalum Oopenaur is a great draining stream, which falls into the Coleroon a short distance after crossing the old road from Madras to Tanjore, and always caused most serious difficulties to the traffic.

This bridge was commenced in 1848, but the excessive difficulty experienced in sinking the foundations, owing to the nature of the soil, and the abundant water springs, together with the inexperience of the executive servants, led to a greatly increased outlay. The work was comple-

ed in 1849, in which year the arches were built and the roadway was opened.

The foundations are of wells, filled in with jelly ; the piers are of brick, faced with cut stone, and the superstructure is entirely of brick masonry. The height of the piers is 10 feet, the rise of the arch 12 feet and the breadth of roadway is 24 feet including parapets.

The greatest possible advantage has resulted to the extensive traffic along this line by the construction of this useful bridge.

(Signed) E. LAWFORD,
Civil Engineer.

7TH DIVISION 1848-49.

In the seventh division the only works of importance that have been carried on in 1848 and 1849 are the opening of the Perambaddy pass, the Calicut and the Tanoor canals, and an apron of timber to the Yennamakul dam ; the completion of the Hassanoor ghaut, the erection of a timber bridge at Teppacaudoo, and the investigation of the Annamallay teak forests, with the preliminary arrangements for working them.

2. To give a really useful account of these undertakings, I should bring to notice the executive difficulties met with during their progress and the means taken to overcome them, but as Civil Engineer I was but an occasional visitor at each work, while the execution was entirely in the hands of others, whose labour from day to day could only be reported upon by themselves. The *Perambady* pass was managed by Mr. Francis ; Mr. Conolly took the sole control of the Calicut and Tanoor canals, Corporal Armstrong had charge of the apron at Yennamakul—Lieut. Chauncey of the 39th Regiment N. I., had the Hassanoor pass ; the

Teppicaudoo bridge having been previously prepared at Hoonsoor was placed in position, during my absence on leave, by Captain Ouchterlony aided by Lieut. Moberly and Serjeant Loftus. In the investigation of the Annamalaiy forests I was more personally engaged, but in the tracing of roads and actual executive Lieut. Michael of the 39th Regiment N. I. was the responsible Officer.

3. Such information however as I am able to collect from the several Executive Officers I will now briefly detail.

4. The "PERAMBADY PASS"—On my first taking charge of the 7th Division in 1842 I found that there was no tolerable road from the interior either to the great trading town of Tellicherry, or to the Arsenal and Military Station of Cannanore. The only road practicable for wheels being by the Periah pass which from its steepness could not be kept in such condition as to be used by bandies during the rainy months, a season in that part of India occupying a third of the year. The roads both above and below that pass are most dangerous from the fevers that infest them, and the ghaut itself is so situated in a narrow gorge that it could not be remodelled. At that time I began a general examination of all the western passes and as a substitute for the Periah found a good and direct line through Coorg, which I determined at once to work out if the Government allowed me the means. This was done and as I was so fortunate as to have Lieut. Francis for my Head Assistant, I left the tracing and estimating of the line entirely to his management. These preliminary operations occupied the dry seasons of 44 and 45 and ended in a most skilful trace being cut from the frontiers of Coorg to the coast of Cannanore—and an estimate being prepared in minute detail the amount of which was Rupees 200,376.

5. The Perambaddy ghaut makes a descent from the level of Coorg to the plain of Malabar a fall of about 3,000 feet in a distance of 10 miles the inclination varying from 1 in 18 to 1 in 24 with a very short grade 1 in 16. There

is no counter slope in any part of the line and only a few yards of level. There is some loss in distance in winding from one valley to another but no zigzags or acute angles any where. On the whole the pass is far more free from such drawbacks than could have been imagined when the forest covered mountain side was first examined. Besides the ghaut itself the estimate covers the cost of the road above and below from the frontiers of Coorg to the station of Cannanore a distance including the pass of 80 miles. It allows for bridging all streams but one, the Burrapolay river, where for the present there will be a platform ferry. On the ghaut the drainage will be entirely covered and strong soil or metal will be placed on the surface where the original soil is very unfavorable, but the expense of metalling the roads throughout is not included in the estimate, because till the line has been brought into use sometime it will not be required.

6. The objects of this line of communication are to connect the great Western trunk road from Madras with Cannanore, while a short branch will connect it with Telli-cherry one of the most important towns on the Western Coast.

7. In December 1846 Lord Tweeddale visited the trace himself, saw its great importance, as well as the admirable skill shown by Lieutenant Francis in laying it out, and recommended the project strongly to the Home Government. The consequence of which was that sanction was granted for the expenditure. As soon as notification reached me of this I wrote in conjunction with Mr. Conolly (the Collector of Malabar) suggesting that the Officer who had shown so much talent in the trace, and who was then on leave in England, should be offered the appointment of Executive Engineer to complete his own work. Mr. Dickinson who then held the Government gave his assent to this proposal and moreover determined that to make the compliment more marked the offer should be sent through

the authorities at home. This was done, Lieutenant Francis gave up the remaining portion of his leave and returned to the country to carry out the project.

8. On his arrival he found his tracé widened and used by droves of laden bullocks, Mr. Onslow, the Superintendent of Coorg, who never lost time if he could help it in making an improvement in his district, having in communication with me and in anticipation of the grant for the whole sum obtained sanction for an outlay of 6,000 Rupees to render the trace practicable. This small work some little executed by a party of Sappers near the head of the pass; and the opening of a few miles in the neighbourhood of Cannanore, was all that had been done up to the time of Mr. Francis' taking charge in 1848; since which time the work has proceeded rapidly and for the most part satisfactorily, so much so that no detailed account of any portion of the work has been reported, for here, as elsewhere, while losses and accidents are not met with, no written record of the work is sent to me except in terms too general to be of any use. Mr. Francis sets great value on the services of his European Subordinates both Commissioned and Non-Commissioned. They have evidently taken a real interest in the work and the reduction of cost where they have been engaged shows how great a saving may be effected by the money spent in their allowances; and the value of such Overseers after they have served for a while under the orders of an Executive Engineer is, of course, very greatly enhanced. When they have had actually to take part in a great work and learnt that almost all difficulties are to be overcome when met with energy, they gain confidence in their own ability and are fit to take upon themselves the entire management of such undertakings. I have ever advocated the employment of Europeans in the Civil Engineer's Department and I see every day their value more clearly shown; I am perfectly sure that the ordinary works of irrigation in the district, the cross roads and buildings should

all have the advantage of their superintendence, not only as a security against a waste of large sums on works under execution, but in honesty to the labourers employed. This use of European Overseers, and their having a practical education I consider so important that I make no apology for mentioning the subject at some length here.

9. The greatest difficulty that Lieutenant Francis has had to contend against, is fever, which at the bottom of the pass has this season taken a very virulent form and so kept guard on its favorite river that all efforts to complete a bridge over the Kullaur have been unsuccessful. Warburg's fever medicine though most invaluable in saving the lives of those attacked had no chance against the continued returns of the disease on those who were permanently located there. Effort after effort was made to continue the building but no inducement could keep the people to their work. The fever gained the victory, the incomplete work has been destroyed by the floods of the monsoon and our only hope is in a less feverish season in the coming year. There is evidently much less fever in these Western jungles in some years than in others, and the character of the disease is very variable also. As a general thing we have no dread of the jungle during the day, nor do we fear them either when the woods are dry enough to burn or saturated fully by the rains. We have it is true one or two striking exceptions to this where the fever appears to be ever present but usually we can make sure of safety if we leave the dangerous spots at night, or work only during the very hot or very rainy months. This season there seems to have been no security in the jungle any where, fevers were caught in what we considered healthy situations ; it took, as I have said, an unusually violent form on the banks of the Kullaur, and in several instances it attacked those who had only spent the day within its influence. In the Engineering of the Western ghaut this disease is a greater impediment to our operations than the hardest rocks. No esti-

mate can make allowance for the losses it occasions, nor can any skill or care avert its mischief. In Warburg's fever drops we have a most valuable auxiliary and where that is known to be at hand, the coolies learn its power and remain with confidence where they could not otherwise be induced to work.

10. There is still a year's work at least to be done on the Perambaddy after which should it have been completed Mr. Francois will I hope give a detailed account of his proceedings, than which no paper on the works of Engineering in my division could be more interesting.

11. Besides its value in a Military point of view as an approach to Cannanore which is not only the principal Cantonment and Arsenal of the Western Coast, but the port at which a force could best be collected for embarkation on Steamers—there is no doubt that the trade upon it will be very great and the benefit accruing will be felt both by the Astagram Division of Mysore and our trading town of Tellicherry. To the former it will be invaluable, as since the country has come under European management the expenditure of money in the great markets of the interior, Mysore and Seringapatam, has decreased, while a general improvement of the condition of the inhabitants by good Government, the removal of the transit duties and security given to property, have left such an outlet for its produce its only want.

12. "THE CALICUT CANAL."—In the office of the Collector of Malabar there are many abortive papers upon the improvement of the inland navigation of the district by a junction of its backwaters, the map of the country having no doubt always given a general idea of the practicability of such a work, while examinations in detail have ended in estimates too great in amount to suit the views of Government,

13. To Mr. Conolly the present Collector of Malabar the works now executed, and in progress, are entirely due.

After frequent enquiries as to where the backwaters most nearly approached each other; for the nature of the country forbids a general observation of the ground; he came to the conclusion that the estimates of former times were for expensive undertakings now found to be quite unnecessary. He called upon me to inspect the lines that he proposed to open and I agreed with him at once that there could be no objections made to them, provided the land through which they passed could be obtained from those who owned it, not the least difficult part of such a project in his district where land is so much prized that money cannot purchase it. Mr. Conolly however was from his popularity well able to overcome this difficulty. The Zamorin Royah gave the portion that belonged to him and all others on explanation, seeing the value of the work and knowing that they might trust to the Collector for indemnity in case of loss, withdrew all opposition and it is now found that the land in general has been so much improved by better drainage that the cultivators are in many cases no less benefitted by the channels than those who use them as a means of transit.

14. The first executed as a part of this important line of works were the Pyolee canal, and a cut to enable boats coming down the Coottiaddy river to land their cargo at the port of Vuddagherry. These though of great value to the country were finished before 1848.

15. The next project proposed by Mr. Conolly was to connect the Ellatoor and Beypoor backwater which entailed a cutting six miles long, the greater part of which was through low ground; but at three points high land had to be cut through. The backwaters being both under the influence of the same tide no lockage was required, and only two carriage roads being intercepted by it the cost of bridging was a trifle. My estimate for the work prepared on data approved at the time amounted to Rupees 15,333 and received the sanction of Government on the 25th August

1846. The most liberal view was taken of this project by all to whom it was submitted, as Mr. Conolly pointed out at the time he recommended it to the notice of the Board and Government, that beside its not yielding a direct revenue it would lessen the receipt of duty upon grain which if shipped and landed even in the same district had a charge upon it, and entailed no inconsiderable loss, as one great object of the navigation is to take the rice of Southern Malabar to the Talooks in the North where popper is the produce.

16. The execution of the Calicut canal was undertaken by Mr. Conolly himself who fortunately lived within a moderate distance of the line. The executive difficulties that at first presented themselves were a rapid and destructive stream that in the freshes left the Tamboricherry river and flowed into a charly or small lake through which the navigation had to pass, and the cutting through two considerable parambas or high laterite ridges. The stream from the Tambercherry river was found to come in from a breach and have a fall so great as to threaten in the course of time the turning of the whole current should it be allowed to flow into the lake and make its exit by the Northern entrance of the canal. This breach was therefore closed, since which much of the lake has been reclaimed for cultivation. In the cuttings there was no difficulty that could not be overcome by time and money but as our estimate had been made as low as possible, it required all Mr. Conolly's attention to keep the cost within its proper limit—and where the laterite was of a nature fit for building it was quarried for that purpose and sold in Calicut to pay the cost of cutting. By this means and good economy in all parts of the work we should have finished the canal within our estimate, had not several difficulties undetectable before the work commenced been met with when the ground was opened. In one spot, as it appears to us, some ancient artificial reservoir was found which contained a soil so fluid,

that in the rainy season it springs into the canal and destroys the bottom loading the bed with mud of greater specific gravity than laterite stone. Here and there boulders of granite intercepted us, such as no specification could have hit upon ; added to which the unfinished work was injured by the rains. In short we found in this, as must be in all similar undertakings, that after estimating for all that we could see and fancy, there were some few buried obstacles that were not in the list. In every cutting of a great extent this must surely be, for if the lower soil is not exactly what is looked for, as it never will be it is as certain to be *harder* than the ground above it, so that the average is against us always ; in this case we had to call for an additional sum of 3,096 Rupees which was sanctioned and the work completed with some help from Convict labour, at a cost altogether of 18,429 Rupees. The cheapest work of its extent and importance I have ever seen.

17. The next estimate was for the Tannoor canal by which, in continuation of the navigation abovementioned, the Beypoor river would be united with Ponany, and the important town of that name have an inland water communication with Calicut and all the coast towns as far as Vud-dagherry, i. e. within 12 miles of Tellicherry—a distance of 60 miles. The estimate for this is 8,259 Rupees and the work is still in progress, having been delayed by more than one accident, and thrown back by our meeting with a bed of sand of the finest description 30½ feet in depth, to overcome this at a moderate expense we have been trying to lead a stream from the Beypoor river through it, and good success was attending the effort, when the failure of the embankment at the head of the canal reduced our command over the stream, the Beypoor river rising occasionally 22 feet in a few hours. The greater part of this line is through low ground for which the canal will be a valuable drain and enable the cultivators to make use of their land earlier in the year.

18. The only works of masonry on this portion of the canal are a small sluice at the Southern extremity and a high gateway at the entrance from the Beypoor river in the North. The former of these allows the drainage to escape and gives passage for boats into the Ponany during the monsoon, after which it is closed to prevent the ingress of saltwater. The latter is in like manner a communication between the canal and the other river but the object of closing it is altogether different, the water being fresh at all seasons and the danger being from the high floods of the monsoon. This work was not carried out according to my plan nor was it well secured before the freshes in June 1849—in consequence of which the work was so much injured that it was necessary to remove and restore it—the loss by this was 407 Rupees. The work consists of two wing walls 24 feet high of laterite in chunam with an apron of granite. The opening being 8 feet wide, which will be closed before the monsoon sets in by beams a foot square in section dropt horizontally into grooves. This plan was adopted rather than a gate as it was safe and simple and could not be mismanaged. By this gate when the whole work is completed the canal may be supplied with fresh water throughout the year. Great use is already made of the Southern portion of this, but it will be sometime before the Northern end can be completed. So far the communication is finished or in progress; it only remains now for the Ponany river to be connected with the Chowghaut back-water to extend the navigation to Travancore and give a continued communication for a distance of two hundred and twenty miles. An estimate amounting to 6,995 Rupees was sent in for this purpose in November last, Mr. Conolly urged the expenditure, and the Board strongly recommended it with an addition to my estimate of 2,000 Rupees but sanction was refused. This addition to the estimate might very possibly have been required and the work was so well worth the expenditure that nothing could be more judicious.

than the recommendation. I would however venture to suggest that in such cases, all mention of the addition having been granted should be withheld from the Civil Engineer and Collector, as from their offices, the sanctioned sum becomes known and the outlay is almost always regulated accordingly. If a reservation to such an extent to cover all contingencies could exist in the minds of the controlling authorities it would relieve us from the alternative of making estimates to cover their cost or taking the responsibility of supplemental demands.

19. THE "YENNAMUCKLE APRON."—The works at Yennamuckle consist of an earthern embankment 550 yards in length and a Calingulah or Weir 110 yards from wing wall to wing wall. Their effect is to exclude the tide water while the drainage of the country has a free passage to the sea and their object to fit a great portion of the bed of the lake for cultivation, which would otherwise be under salt-water six months of the year. The backwater, as it would otherwise be called, is by these means converted into a lake, and being shallow, much of its bed becomes cultivable by the evaporation of the spring months. A still greater extent however would be useless from the depth of water over it, were it not for a wheel, evidently an introduction of the Dutch settlers of Cochin, by which land two and a half feet below the surface is cleared for tillage. Altogether the extent of land made use of is very great, but belonging chiefly to the Cochin Government, we have no accounts from which to state the measurement. I think I may safely say that the crop to the people and the Government of that State is worth at least 60,000 Rupces a year.

20. The Yennamuckle works were projected in the year 1841 by Captain Ditmas by order of Government, in consequence of a representation made by the Cochin Resident to the effect, that an Assistant Collector of Malabar in the Company's Service having cut through a certain bank to reduce the water in the lake, an annual expense of

800 Rupees had been entailed on Cochin for the security of its cultivation. As I have elsewhere frequently stated the Cochin State reaped far more than 800 Rupees a year by the reduction of the water and had in fact no ground whatever for complaint. The Government however took another view of the case and the sum of 30,879 Rupees was sanctioned for a permanent work. The sum though insufficient was large and it was a great object not to make it larger still. The dam has answered its purpose well showing that had the Calingulah been of more permanent material and more liberal dimensions the project would have effected all that was required. Too great economy in short caused an eventual loss of 40,500 Rupees.

21. This loss to the Company is very considerable no doubt and ought never to have occurred, but the money has been by no means lost altogether, inasmuch as it has led to a great increase of cultivation in the Cochin country and was undoubtedly the saving of the whole harvest in the month of April 1847—when a storm visited the Western Coast such as on all former occasions had destroyed the temporary dam and laid under salt water all the lands in the lake, a loss to the people and the state which in the year 1847 would have amounted to 60,000 Rupees at least.

22. In 1842 I took charge of the seventh division and found the work approaching to completion, I wished to have a granite apron but the Chief Engineer wrote to me what was perfectly correct that too large a sum had been sanctioned for such a purpose already. In 1845 it was evident that the laterite was yielding to the current and overfall. In 1846 the apron was repaired and in some degree widened and improved. In 1847 the work showed further signs of failure and as the most economical mode of securing this most unsatisfactory building I suggested an apron of timber, which as it was to be always some feet under saltwater, I felt sure would last for a good many years. The wood I selected for the purpose was "Irooool".

but a rather more expensive kind "Iyany" was recommended by the Board of Revenue, under the supposition that it was better suited to the purpose. Either would in that position have lasted a great length of time.

23. My plan for this apron as given to the Overseer in charge was as follows :

Piles 11 feet in length were to be driven over the whole space in line 7 feet apart the piles in the other direction being 25 feet from each other. Cross beams or sleepers were then to be dovetailed on the heads of the piles and upon them planking 3 inches in thickness was to be fastened by teak trunnels having wedges driven in above and below to prevent their drawing. I was unable to visit Yennamakul till the 12th March 1849 when I found preparations making for taking the water from the old apron, the lower part of which at spring tides was 12 feet below the surface. A dam was thrown round the space and the wheels used in the cultivation of the lake brought into play, than which nothing could have suited better. Having given my instructions to Corporal Armstrong I proceeded to Cochin from which I sent him a head Carpenter and 5 of his men, Ship builders, admirably suited to the work. I then left my division on leave of absence and proceeded to Ceylon. My appointment being held during my absence by Captain Ouchterlony, who was fully occupied on the Hassanoor ghaut, Teppacaudoo bridge, and other works more than a hundred miles distant from Yennamakul. On the 22d April 1849 I returned from Ceylon and went immediately to Yennamakul, where I found the work proceeding to all appearance, most satisfactorily—one change however had been made in my plan which was that a slope had been given to the apron. This was done by the Overseer because he found on removing the water, that the body of the work above the level of the apron was so much injured that he did not consider it safe to leave it exposed. The fall made a considerable difference in the security of the apron by

giving the water a set downwards and tendency to undermine the outer piling. As however the lower end of the apron was 6 feet below the surface of low water and the piling allowed was 11 feet in length, I still hoped it was safe but pointed out to the Corporal the additional necessity for placing all the loose stone and rubble that was at hand along the outer row of piles. The workmanship of the platform was as good as is used in the deck of a ship and all the Carpentry indeed was excellent. I left Yennamakul and on the 20th of May 1849 a report reached me that the work was completed, there being no fear of the monsoon freshes till the first week in June. In July 1849 I received intelligence that the apron was floating up, evidently destroyed, and there being at that time deep water over the Calingulah nothing could be done, but in November 1849 when the current was decreasing I proceeded to the spot and found the platform in some parts broken up, some portions in position and a considerable extent raised nearly to the height of the crest of the Calingulah still perfectly unbroken, and bearing even at that time a heavy torrent upon the planking. It was very soon evident that nothing had failed from want of strength or skill, and that the sole cause of failure was the piles having drawn, but what had led to that did not at first appear. Upon examination of the wood that was collected from the bank of the river the origin of the mischief was evident enough, the piles had been in many cases cut 6 feet shorter than was allowed. Not one which was found was of the proper length, and some of them had evidently hardly been driven at all. Nor was this to be accounted for by obstacles met with while driving them for the points were perfectly uninjured. The whole work was lost from this extraordinary want either of care or judgment on the part of the Overseer. Had this been done by any one whose character was unknown to me I should no doubt have supposed that money had been made by the missing timber, but the Overseer was perfectly trustworthy and indeed the wood cut from the

piles was in store. It was one of those blunders or oversights that showed beyond a question that the Non-Commissioned Officer had altogether mistaken his profession, and I had for once the annoyance of thinking that had I left the work to any Native Maistry such a misfortune never could have occurred.* The loss by this failure was 8,758 Rupees and from the absence of the apron the work was still further injured and so completely shaken that I was under the necessity of condemning it.

24. A new project has since been sent in, for a dam near the sea upon what I consider a more secure section, and far more advantageous site.

25. With regard to this failure and the blame being thrown upon the Overseer, I may observe that under no circumstances could I have given more of my time to Yennamakul, indeed had I not gone on leave to Ceylon and by returning to Calicut came again within reach of Yennamakul, I could only have seen it once while it was in progress, as my tour would have made it impossible for me to reach it again before its completion, so entirely am I, as Civil Engineer, dependent upon others for the execution of my projects.

THE "HASSANOOOR GHAUT."

26. This ghaut was originally traced by the late Lieutenant Fast as a substitute for the Guzzlehutty an ancient pass between Mysore and Coimbatore, too steep for wheels and from its course along the ridge of a spur so circumstanced, that no alteration short of an entirely new pass could make a practicable road in that locality. Mr. Fast was a most talented and zealous young Officer, who had already distinguished himself in the traces of the Palmanair and Sumpajee ghauts, and died of jungle fever from an excess of zeal while superintending this his last project. What led Mr. Fast to abandon the Guzzlehutty ravine and select this line I do not exactly know, he may perhaps have set

* The only case in which an European Overseer has disappointed me.

greater value on a road through the hilly country of Colligal than I have done, but on no other ground can I understand his having chosen this line for his new pass. Some time before the Coimbatore district became a part of my division, this question however had been disposed of, and the pass had, under several different Superintendents, been opened to a certain extent, but for two years was left untouched in consequence of the great loss of life its foyers had occasioned amongst the work people. When I made my first tour in Coimbatore I was called upon by the Board of Revenue to report upon the actual condition of the pass and give my opinion as to what should be done regarding it. My report contained my reasons for regretting that the Hassanoor ghaut had ever been begun, but as the sum required for making a road for wheel carriages by the completion of that pass, was much smaller than could open such a communication, between Mysore and Coimbatore by the Guzzlehutty on any other route, I recommended that the work should be carried out with this alteration in the original project, that the breadth of the pass should not be made uniform, but reduced to 9 feet, where the cutting of rocks would entail a great and, as I considered, an unnecessary outlay on a line, which when completed, would not be one of first rate importance, and for a length of time at all events have no traffic upon it, moving at a greater velocity than three miles an hour. For the work I recommended, 11,052 Rupees would, I felt sure, be sufficient, and to make the utmost of that I suggested the employment of a Commissioned Officer in the management of the executive. In similar cases I have always advocated such an appointment as good economy and here I had as an additional reason for my doing so, my anxiety to prevent as far as possible all further sacrifice of life.

27. The Officer selected was Lieutenant Chauncey of the 39th Regiment, than whom a better man could not have been chosen, and the result of his good management

affords a remarkable proof of the disadvantage under which Civil Engineers in this country labour, when leaving their projects to the care of the ordinary talook servants. Mr. Chauncey was employed during two seasons on the Hassanoor line and had no loss whatever by fever, while he established such a good understanding with the work people, that, in spite of the horror in which the name of the pass was formerly held, he had more volunteers than he could employ, though paying only the same rate that is allowed for labour in the open country of Coimbatore. That he saved his men from the fatal effects of fever, was to be attributed in part to a judicious selection of positions for his camps at the different seasons and in no slight degree to his having his people paid up to the day, and so perfectly at liberty to go and come at will, that no one need remain an hour when fever had attacked him—that his work was carried on by voluntary labour and that so many more coolies came to him for employment than he could engage, was in consequence of his seeing the labourers paid himself.

28. The Hassanoor ghaut with the road above to the frontiers of Mysore and the road below to the town of Suttimungalam were completed in September 1849—but in consequence of the line not being carried on through the frontier jungle of Mysore no bandies yet are used upon it. The traffic on this line of road will never be very great i. e. not to be compared with one of those lines which leads directly from the interior to the Coast, but it will be of value to the South Western towns of Mysore and those of Coimbatore and Trichinopoly and perhaps Madura, by giving them an easy communication suitable for carts.

The total expenditure on works connected with this line is as follows.

On the road	Rupees..	19,999
Establishment,	Rupees..	3,272
		23,271

THE "TEPPACAUDOO BRIDGE."

29. The river over which this bridge is thrown, is the Moyaur a main branch of the Bowany and tributary of the Cavary, having its source on the Neilgherries, the Northern slopes of which it drains. Its course follows the line of the mountains, its bed at Teppacaudoo being nearly on a level with the country, while a few miles lower down it forms a deep and precipitous ravine a thousand feet in depth, the opposite sides of which are not more than from two to three thousand feet apart. This curious feature in the plain is known by the name of the Mysore ditch.

30. The road from Ootacamund to Bangalore was led to Teppacaudoo somewhat out of the line, to avoid this ravine, and a timber platform on brick abutments was thrown across the river some years ago, but as unseasoned teak seems to have been used, probably because no other could then be procured, and from its parts shrinking and decaying, the bridge failed in 1847. The site of this work was well chosen, as the abutments were on rock and the space between them such that it could be spanned by one well arranged truss. I believe that bridge to have been very good in all particulars but the want of durability in its material.

31. I took the same site for the new bridge too happy to take advantage of the old abutments and save so much risk from keeping men employed in such a dangerous locality. Teppacaudoo is never free from fever I believe, at all events our late experience goes to prove that in no season is it safe to sleep there. I had understood that there was great sickness and some loss of life when the bridge was first erected, and I determined if possible to make such arrangements as should reduce all danger to the utmost, with a view to this I made my bridge of the simplest form I could and so that the number of pieces of timber used should be as small as possible. I used the best teak I could procure in the neighbourhood of Hoonsoor, in which establishment I

had the bridge prepared so that not a day should be unnecessarily spent in labour at Teppacaudoo. The centring for the bridge was of the rudest kind admirably suited to the place and purpose, as it could be put together with great rapidity by the coolies of the country out of material found in abundance close at hand, in the use of which they were skilful. A few small straight trees were cut for uprights and a scaffolding of bamboos lashed together did all that was required. I was absent from my division when the bridge arrived at Teppacaudoo, so that I cannot give an exact account of the number of days spent in placing it in position, I found however on my return that it had been so far completed that the centring could be removed, and the planking laid down temporarily for use, and that up to that time there had been no loss from fever. That fearful disease had just begun to show itself, so I put a stop to the work at once and sent away those who were suffering from it, in bandies to other homes. Had I been at Teppacaudoo only two or three days later in all probability I should have lost several people, but as it was I gained my point and have since completed the work without loss of life.

32. The span of the bridge is 69 feet and its height above the bed of the river 38 feet, its cost Rupees 3,000.

ANNAMULLAY FOREST.

33. Though the examination of the Annamullay teak forests occupied a good deal of my time in 1848 and 1849 there is no work executed for me to report upon. I have this year begun to work the forest on account of Government, and if I can get wood cutters in numbers sufficient to work on a great scale I shall be able to store such wood at Ponany on the Western Coast for half a Rupee a cubic foot as has cost the Bombay Government hitherto $2\frac{1}{2}$ Rupees. A reduction of expense which at the present time when no large ships are building will amount to two lacs of Rupees annually, when the Men of War were on the stocks

MAIN DRAINS AND CESSPOOLS IN THE TOWN OF MADURA.

Estimate Rupees..2,830

On the 3d February 1847 I drew up by direction of the Board, a report on the Madura town drainage, in which I detailed what had been done up to that time, in the construction of main and street drains and pointed out certain defects connected with the former, which the above estimate was intended to remedy. There are altogether 9 main drains in the town of Madura. On the East face 3, communicating with the Anapanuddy channel. Two of these, however, were completed before the present estimate was prepared, and are not, therefore, included therein. The one which is included in the sanctioned estimate is the pagoda main drain, which was only partially completed in the year under review, but has since been fully completed together with the cesspools connected therewith. On the North face there are also 3 main drains communicating with the same channel, two of which are provided for in the above estimate, and were carried into effect during the year 1848 in a satisfactory manner. On the South face of the town there is only one main drain communicating with the Kirthamannudee. This was constructed on the above estimate in 1848, as were also 2 main drains on the West face, within the estimated amount, and were favorably reported of by the members of this department. A third main drain on the West face remained to be constructed on the sanctioned estimate. The total expenditure during the year 1848 on the abovementioned works was Rupees 1,744 leaving a balance of Rupees 1,085 to complete what remained in 1849. The drains are constructed of old fort stones (granite) backed with brick in chunam, and covered on top with the same material. The size of the vents average 4 by 3 feet and connected with each main drain, there are a certain number of cesspools to receive the drainage of the streets, under which

it passes in its way to one or other of the abovementioned channels.

BRIDGE OF 3 ARCHES OVER THE OOPAUR ON ROAD NO. 5 AND REPAIRS TO THE SAME ROAD.

Estimate Rupees..2,903

The above road leaves the high road No. 4 from Trichinopoly to Madura about 1 mile North of Meyloor and proceeds via Thiroopoothoor to Tondiman Poothoocotta, the capital of the state of that name, and thence to Tanjore. The above estimate provided for repairs and improvements to the first 9½ miles of the road within the Government limits, and for constructing a bridge of 3 arches, centre arch 15 feet and side arches each 12 feet, across the stream, called the Oopaur, which from its size and the false nature of the bed frequently caused detention. During the year 1846 and 47, work to the value of Rupees 324 was executed and brought to account. This included only earth work and open drains. In 1848, the bridge across the Oopaur was constructed with good materials and workmanship, the materials being brick in chunam throughout. The total cost of the bridge was Rupees 1,212 which left a balance on the estimate of Rupees 140. Of this latter sum, Rupees 56 remained to be expended in raising the approaches to the bridge, and Rupees 4 for guard stones, both which were carried into effect subsequently to my visit on the 18th October 1848. The saving of Rupees 80 on the estimate for the bridge was recommended to be laid out in gravelling the approaches to the same, the subsoil being of a bad description for roads. Some additional earth work and another open drain or pavement were likewise executed during the year under review, the total expenditure being Rupees 1,482 or together with that of previous years, Rupees 1,807. A bridge of 12 by 6 feet and 4 tunnels of 1½ by ¾ feet remained to be executed in 1849 to complete the work in accordance with the estimate.

BRIDGE OF 3 ARCHES ACROSS THE HEAD OF THIROO-
POOVANUM CHANNEL ON ROAD No. 15.

Original estimate..... Rupees.. 1,849

Supplemental do..... Rupees.. 466

This work was commenced in 1846, during which year the foundations of the piers and abutments were laid, and in the following year, the work above foundations, and part of the arch work was carried into effect, but owing to a sudden and very high fresh in the Vigay River, an accident happened which put a stop to the work for that year, and caused a loss of Rupees 485 to Government. The water overtopped the embankment in front of the work, breached the left bank of the channel, and carried away the 2 side arches of 12 feet span, which had been completed only a short time previous. The centring of the centre arch of 24 feet span was likewise carried away. Every precaution had been previously taken to guard against injury, but in consequence of the extraordinary height of the fresh, together with the inundation of the country in its vicinity, the injury sustained could in no way be prevented. A supplemental estimate, as above, having received the sanction of Government, the work was put in hand early in 1848 and completed during that year in a creditable style and with good materials, with the exception of a portion of the plastering, some earth work to the approaches, and curb stones at the four corners of the bridge roadway, which remained to be done in 1849. The expenditure in 1848 was Rs. 813 which added to that of 1847 made a total of Rupees 2,222 leaving a balance of Rupees 93 for work to be executed in 1849.

REPAIRS TO ROAD No. 2 BETWEEN DINDIGUL AND PULNEY.

Estimate Rupees.. 6,519

The repairs provided for in the above estimate are confined principally to 4½ miles of black cotton soil, which occurs on this line of road between the villages of Chutramputty and Cannacumputty. The estimate allowed for cut-

ting side trenches and raising the road with earth in the first instance about $\frac{2}{3}$ ths of a yard above the general level of the country, and for covering the surface with broken stones, 9 inches in depth, procured from pits opened at intervals along the line of road, and these again with a coating of gravel obtained from the same pits. It also provided for the construction of 4 curved pavements for the drainage to pass off by, and for removing projecting rocks. In 1848 the amount expended on this work was Rupees 2,442 which added to the previous years' expenditure made a total of Rupees 4,253. The remainder was carried into effect in 1849. The reports of this department on the work executed in 1848 were on the whole favorable.

PAULAUR RIVER WAGGANIES.

Estimate..... Rupees.. 2,407

This work was recommended with the view of straightening the course of the stream and thereby preserving the topes and cultivation on the right bank of the Paulaur from injury during high freshes. In 1847, two new cuts were made through bends in the rivers banks, and the former channel closed by strong embankments, and in the following year 1848, two, out of the three Wagganies estimated for were constructed, and another cutting made to the Eastward of the former. Notwithstanding the damage sustained by a high fresh in the river on the 10th September 1848 the project was found on my examination of the work on the 16th October following to have answered the purpose very well, as far as it had progressed. The new cut had become the proper channel of the river, the old one being permanently closed, and there appeared every reason to hope when the works were fully completed that the desired object would be fully attained. The amount expended in 1848 was Rupees 502 and in previous years Rupees 1,427 making a total of Rupees 1,930.

COONOOR ANNICUT.

Estimate Rupees .. 2,050-8

The cultivation under this Annicut had fallen off considerably for want of a sufficient quantity of water, the body of the work being in a very leaky state and the head of the channel too confined. The above outlay was recommended with a view of restoring the Annicut to an efficient state. The repairs executed in 1848 consisted of a front wall of brick in chunam, and rebuilding the crown of the work with large rough stones set in chunam, the interstices between them being carefully filled in with rubble in cement. The head of the channel had been previously (viz in 1847) widened agreeably to the provisions of the estimate. The total expenditure was Rupees 1,975 the saving on the estimate being chiefly in the item for "front wall," it having been built in part at a less depth than the estimate provided, owing to the presence of rock in the foundations. The materials and workmanship were of good quality.

MADURA 1849.

MAIN DRAINS AND CESSPOOLS.

Estimate Rupees .. 2,830

In the report on this work for 1848 I described all that had been done up to the end of that year. The work performed in 1849 consisted of reconstructing No. 8 or Pagoda main drain on the new line, connecting it with Yellend-dell tank in the first instance, and that again with the portion of the same drain further Eastward communicating with the Anapanuddy channel—3 cesspools were also built in connection with this drain. My report on this work was not very favorable. The total expenditure during the year amounted to Rupees 841 making with that of previous years a total of Rupees 2,586. To complete the drainage of the town, as provided for in the above estimate, 6 open drains on the West face remained to be constructed.

BRIDGE OF 3 ARCHES OVER THE OOPAUR ON ROAD NO.
5 AND REPAIRS TO THE SAME ROAD.

Estimate Rupees.. 2,903

During the year 1849 four tunnels of $1\frac{1}{2}$ by $\frac{2}{3}$ each and a bridge of 12 by 4 were constructed, and some earthwork performed in Congumputty limits in continuation of work done in 1848 on the above estimate. The expenditure in 1849 amounted to Rupees 480. The work was examined by Lieutenant O'Connell, who reported it well executed with the exception of one of the tunnels which had a slight crack in it.

REPAIRS TO ROAD NO. 2.

Estimate Rupees.. 6,519

In the report for 1848, I described the nature of the repairs provided for in the above estimate and the progress made therein to the end of that year. During the year 1849 the remaining work was completed at a cost of Rupees 2,238: making with the former expenditure a total of Rupees 6,492. The work was examined by the Assistant Civil Engineer as well as by myself, and reported of in favorable terms. The portion of road on which this outlay has taken place was formerly one of the worst in the District, the sub-soil being of the description termed "black cotton." It is now in very good order. To keep it so, however, it will be necessary to renew the gravel over the broken stone every second or third year.

ROAD NO. 2 BETWEEN DINDIGUL AND PULNEY.

Estimate Rupees.. 4,664

The repairs provided for in this estimate were of the same nature as and in continuation of those performed to this line of road on the estimate sanctioned by Government on the 10th February 1847. In the Jyempully Talook the outlay during the year 1849 amounted to Rupees 1,743 which includes 2 tunnels of 3 by $1\frac{1}{2}$ each and 2 of $1\frac{1}{2}$ by $\frac{2}{3}$ and 1 of $4\frac{1}{2}$ by $2\frac{1}{2}$ completed with the exception of tho

plastering, also one pavement of 15 yards. The foundations and side walls of a bridge of 12 by 4 were likewise built during the year under review, leaving the arch work and superstructure to be carried into effect in the current year. The materials and workmanship were of good quality, and the metalling to the road as far as it had progressed, was also satisfactory. In the Nellacotta Talook, the outlay in 1849 amounted to Rupees 753. The repairs &c. executed consisted of raising the road and gravelling above in four several limits, and constructing a pavement of 15 yards. The earth and gravel works were incomplete when I inspected them, and my report on the whole was not favorable. In the Toddicombo Talook, the expenditure amounted only to Rupees 99 for raising the road, which was also examined by me and found to require levelling and tamping. The total expenditure in the 3 Talooks for the year under review amounted to Rupees 2,595-9 leaving a balance of Rupees 2,069-6 to complete the work during the current year.

REBUILDING CAUSEWAY ACROSS THE VIGAY RIVER AT MADURA.

Amount of estimate..... Rupees.. 2,750

The former causeway, constructed by convicts, of old fort stone granite slabs of various lengths and breadths laid on the sandy bed of the river without additional support of any kind beneath having been very much injured by freshes, it became necessary to rebuild the work throughout and, in doing so, the method pursued has been to place 3 lines of stone endwise to serve as retaining walls to the pavement, and prevent the sand being removed from under it, besides giving support to the horizontal layer of stones above, one end of which rests on these uprights, and the other end on stones placed lengthwise, midway between two lines of uprights. The spaces between the stones are afterwards filled in with rubble in cement. The total length of the causeway is 1,095 feet, of which 504 feet were constructed in 1849 at

a cost of Rupees 1,173-15. The workmanship was satisfactory in every respect. The remaining portion of the work will be completed, it is expected, during the current year.

SUPPLYING CHANNEL OF VADDAKURRAY TANK FROM THE PERDANAI ON THE VIGAY RIVER.

Estimate	Rupees..2,079
Cost	Rupees..1,726

The above estimate provided for raising and widening the right bank of the channel almost throughout its whole course to the Vadakarray tank, and for repairing 6 sluices of irrigation in the same, besides sundry other items for masonry-work. During the year 1849, earthwork to the amount of Rupees 1,505 was carried into effect and 2, out of the 6 sluices, were repaired. A wing wall to the Pareanai on the Vigay river and a revetment across a breach in the channel were also constructed, the total cost being Rupees 1,726. The remaining work will be carried into effect during the current year.

COTTON GIN HOUSE AT SHEVACAUSEE IN THE SAUTOOR TALOOK.

Estimate.....	Rupees..2,699
Cost	Rupees..2,685

This building is intended to accommodate two 60 saw gins, worked by cattle, and three hand gins. It consists of 3 rooms on the ground floor and the same number above. The centre room measures 30 by 20 feet and the side rooms each 20 feet square. The gins are intended to be placed in the side rooms above, the centre room being what is termed the "Lint Room." The moving power in each case is in the centre room below, and the two side rooms adjoining are for storing seed cotton. The approach to the upper story is by stair cases in the lower side rooms. The building is of brick in chunam throughout with a tiled roof and cost Rupees 2,685. The materials and workmanship were on the whole favorably reported of.

BRIDGE OF 3 ARCHES OF 30 FEET SPAN EACH ACROSS
NULLY ODAY ON THE HIGH ROAD FROM MADRAS TO QUILOON
IN THE SAUTOOR TALOOK.

Estimate Rupees.. 4,691

Cost Rupees.. 2,987

The foundations, piers and abutments above and the principal arches were completed in 1846 and 1847 at the cost of Rupees 2,242. The work executed in 1848 consisted of the spandrel arches, superstructure, and plastering; also raising and metalling the approaches, as provided for in the estimate and cost Rupees 744 making a total expenditure of Rupees 2,987. The bridge was constructed throughout with good materials and workmanship. The large saving on the estimate was owing chiefly to the omission of floorings to the arches and to a reduction in the depth of the foundations; rock having been met with sooner than usual in black cotton soil. The construction of this bridge has been of great service to the traffic of the District, particularly to the cotton bandies which were frequently detained on the North bank during the monsoon rains for want of a work of the kind.

FLOORINGS TO 6 OF THE ARCHES OF AMBASAMOODRUM
BRIDGE ACROSS THE TAMBRAPORNEY RIVER IN THE BRE-
MADASUM TALOOK.

Estimate Rupees.. 1,295

The above mentioned bridge was built in 1840 at a cost of Rupees 17,875 the whole of this sum having been raised by subscription in the District. It serves to connect the large manufacturing towns of Culladacoorchy and Ambasamoodrum, the latter being also the station of the Tahsildar. The former floorings to the arches being out of repair, it was deemed necessary to renew them in a more substantial manner giving them at the same time, a curved form instead of horizontal. This was done in 1848 at a cost of Rupees 1,222. The retaining walls in front and rear are

of rough stone in chunam laid at the depth of 6 feet, and the flooring between of rough stone without chunam. The spaces between the cutwaters are likewise floored with rough boulders. The dip, or versed sine of the flooring, is 3 feet and the span of the arches $45\frac{1}{2}$ feet. The work was carried into effect in a satisfactory manner.

REPAIRING HIGH ROAD No. 4 FROM MADRAS TO QUILOON
IN THE LIMITS OF VELLASAYRY AND EDDASHEVIL IN THE
OOTAPADARUM TALOOK.

Estimate Rupees.. 5,311

The repairs provided for in this estimate are in continuation of similar repairs executed in previous years on the sanction of Government, dated 19th July 1842. The natural soil on which the road is formed is of the description termed "black cotton," and the principal of construction is, in the first place to raise the road $\frac{1}{2}$ yard, or more where necessary, above the level of the country with soil from the side trenches, excavated outside the avenue trees, and after this has been properly levelled and tamped, to lay thereon a foundation of broken stones (procured from neighbouring hills or from pits dug for the purpose on the side of the road) 9 inches in thickness, and over these a coating of gravel of the same thickness. This plan is found to answer exceedingly well, provided due care be taken in laying the stones, the larger pieces below, and the smaller ones above, and that the gravel is of good quality. Of the above estimate, work to the amount of Rupees 3,538 was performed in 1848, and the remainder in the following year.

THIMMARAJASAMOODRUM COOTEECAUL ANNICUT ACROSS
THE MONNDEMOOLAUR.

Estimate Rupees.. 2,538

The body of this Annicut was in a very leaky state from one end to the other, the foundations being undermined, causing great waste of water. Its reconstruction appeared preferable to and likely in the long run to be less expensive

than partial repairs, which at the best, would have been very ineffectual. The foundations were of brick in chunam laid on rock at the depth of $2\frac{1}{2}$ yards, and the body of the Annicut above of the same material faced with cut stone, partly old and partly new. The work was carried into effect in a satisfactory manner at a total cost of Rupees 2,486.

THIRANGUL PEREACOLUM IN SAUTOOR TALOOK.

Estimate Rupees.. 1,525

This tank had been in a ruined state for many years previous to 1843 in which year the above estimate was framed for restoring it to an efficient state. To do this, it was necessary to raise and strengthen the tank bund, close a breach at the South end by a wall of rough stones in chunam and repair the Calingulah of discharge and a sluice of irrigation. These particulars were carried into effect in the years 1847 and 1848 at a total cost of Rupees 1,427 and since the latter year the tank has been yielding revenue to Government.

THENTHERAPAIREE HEAD SLUICE IN STREEVIGOONTUM TALOOK.

Estimate Rupees.. 2,709

This work which was of old construction was found to be in a ruinous state throughout, and in need, therefore, of thorough repair. It consisted of 2 vents each 3 by 4 and served to supply water from the Tambrapoor river to 1070 cotays of land yielding a revenue of Rupees 23,031 annually to Government. The foundations of the new work are of brick in chunam, laid at the depth of 9 feet on stiff clay, and the work above, together with the wing walls, are of the same materials, the vents only being faced and floored with cut stone. The total cost amounted to Rupees 2,709.

NENMANY ANNICUT, CHANNEL AND TANK IN SAUTOOR TALOOK.

Estimate Rupees.. 1,262

Cost Rupees.. 1,070

This Annicut suffered injury by the freshes of November 1847, a large breach having been formed at its South East extremity, to close which effectually it was necessary to extend the Annicut for a distance of 44 yards and to connect it by a wing wall with the head of the channel. A further portion of 16 yards in length required to be raised to bring it on a level with the new work. The channel and tank banks, and some old revetments across breaches in the former, also required raising. With the exception of a portion of the earth work to the tank, the additions and repairs were completed at the above cost in a satisfactory manner. The body of the Annicut is of rough stone in chunam, floored on top with brick in chunam.

CUNNADIEN CHANNEL FROM AN ANNICUT ACROSS THE
TAMBRAPOORNY IN SHAIMADEVY TALOOK.

Estimate	Rupees..	2,231
Cost	Rupees..	2,135

Of this amount Rupees 859 were expended for raising the banks and clearing the bed of the above channel of the annual deposit of sand. The remainder is the cost of repairing several sluices and Calingulalis in the same, and of replacing the rough stone apron in rear of the Annicut at its head. The whole of these works were reported on in favorable terms. The channel in question is one of the most, if not the most valuable work in Tinnevelly, yielding, as it does nearly 2 laes of Rupees annually to Government.

TINNEVELLY CHANNEL FROM THE SOOTAMULLAY ANNICUT ACROSS THE TAMBRAPOORNEY IN NELLIUMBALUM TALOOK.

Estimate	Rupees..	1,123
Cost	Rupees..	1,018

Repairs, earth and masonry, similar to those mentioned above were executed to this channel also during the year 1848, with the view to the preservation of existing revenue, which in fusly 1258 amounted to Rupees 63,942.

french, was completed and 6 open drains together with the whole of the bridges and tunnels, one bridge of 6 by 3 in Vandimetta limits alone excepted, constructed with good materials and workmanship at a total cost of Rupees 2,890 leaving the metalling and side trenches to be carried into effect during the current year.

SAME ROAD IN NANGOONAIRY AND VULLIOON TALOOKS.

Estimate Rupees..5,868

This estimate provided for the repair of the most Southern portion of the high road from Madras via Madura, Palamcotta and the Arambooly lines to Travancore within the District of Tinnevelly. The soil is chiefly of a light loam, clay and sand mixed, termed "allar," very false when wet, and requiring to be well raised and drained with a top dressing of gravel. In other parts where the sand predominated, the gravel was dispensed with. Bridges and tunnels and 1 open drain were allowed for different parts of the line wherever necessary and with one or two exceptions were constructed during the year 1849. The whole of the earth and part of the gravel works were completed within the same period, on the whole satisfactorily. The total length of the road repaired on the above estimate was 29 miles and 6 furlongs; and the total expenditure Rupees 4,869, leaving a balance of Rupees 998 for completing the work during the current year.

MAILACUL CHANNEL FROM THE MURDOOR ANNICOUT ON THE SAMBRAPOORNY RIVER.

Estimate Rupees..4,851

Cost Rupees..1,946

This is one of the most important irrigating channels in the Tinnevelly District, the annual revenue derived from it being about 1½ lac of Rupees. Its bed was and is still very much obstructed by rocks, especially in the upper part of its course, and the breadth, also, was deficient, in consequence of which the tanks to the Eastward were a long

time in filling, and it frequently happened that a fresh in the river had subsided before they had received more than a partial supply. This was more particularly the case during the freshes of the South West monsoon, which occur in June and July, and furnish water for the early crops. It was to remedy this evil, that I recommended the above estimate, and upon it work was performed during the year 1849 to the amount of Rupees 1,946. The first 4 miles, 4 furlongs and 170 yards of the channel's course were widened to an average breadth of 14 yards and the bed cleared of rock greatly to the advantage of the tanks to the Eastward.

PAUPANCAUL CHANNEL FROM THE CARAPANUDDEE.

Estimate Rupees.. 1,156

Cost (in 1849)..... Rupees.. 400

In the year 1848 the bed of this channel was widened and cleared of rocks and deposit at a cost of Rupees 557 and during the following year, or that under review, the remainder of the earthwork was completed at the above cost, making a total expenditure of Rs. 1,017. The numerous tanks dependent upon this channel have been greatly benefitted by the above outlay, especially the large tank of Veersakamanee in the Sunkermnarcovil Talook, the crops under which frequently suffered from drought, owing to the bad state of the channel in question.

(Signed) W. H. HORSLEY, Captain,
Civil Engineer 8th Division.

STATEMENT of Disbursements sanctioned on account of Public Works in the several Districts under the Presidency of Fort St. George, for the year 1848.

District.	Ordinary.	Occasional.	Emergent.	Buildings.	Roads and Bridges.	Grand Total.
Arcot (North).....	64,703	.....	4,365	6,303	1,458	76,830
Arcot (South).....	52,717	95,634	4,965	7,112	16,087	1,76,517
Bellary.....	29,334	32,057	245	3,283	1,141	66,062
Canara .....	.....	939	68	16,839	1,05,446	1,23,293
Chingleput.....	88,626	15,558	5,794	11,752	6,844	1,28,577
Coimbatore.....	17,794	200	1,139	15,137	27,546.	61,817
Cuddapah	15,746	1,422	1,299	1,035	3,250	22,754
Ganjam.....	3,153	237	56	971	739	5,157
Guntoor....	24,787	16,707	3,573	3,972	8,076	57,117
Kurnool.....	3,275	2,078	236	359	.....	5,950
Madras	1,551	.....	.....	4,009	.....	5,561
Madura.....	27,755	5,556	982	13,744	9,081	57,119
Malabar.....	.....	.....	.....	16,160	31,260	47,420
Masulipatam.....	8,254	524	946	7,835	5,312	22,872
Nellore.....	38,678	12,955	1,287	4,741	408	58,070
Rajahmundry.....	34,159	2,616	1,439	2,469	1,937	42,622
Salem.....	12,583	.....	299	3,521	1,954	18,358
Tanjore.....	77,818	12,034	5,856	8,079	18,185	1,21,974
Tinnevelly.....	71,937	15,083	3,378	4,483	7,131	1,02,014
Trichinopoly.....	45,290	21,483	8,689	15,632	19,497	1,10,593
Vizagapatam.....	4,757	.....	449	1,036	264	6,506
Total Rs... .	6,22,925	2,35,091	45,071	1,48,481	2,65,622	13,17,192

Exclusive of expenditure under the Superintendent of Roads, and of nearly 5 lacs for the Godaverry Annicut.

STATEMENT of Disbursements on account of Public Works in the several Districts under the Presidency
of Fort St. George; for the year 1849.

Districts.	Ordinary.	Occasional.	Emergent.	Buildings.	Roads and Bridges.*	Grand Total.
Arcot (North).....	45508 6 9	6438 6 4	1821 15 9	4646 15 9	.....	58415 12 7
Arcot (South).....	31743 5 6	3680 7 6	3564 14 9	1818 2 2	16935 6 8	57742 4 9
Bellary.....	23467 15 0	11217 0 0	2282 9 0	1581 0 0	4386 0 0	42934 8 0
Canara.....	.....	.....	.....	8768 0 0	49203 0 0	57971 0 0
Chingleput.....	38532 2 0	5313 3 0	3189 0 0	2049 10 0	2914 1 0	51998 0 0
Coimbatore.....	13484 9 4	1440 2 11	2367 9 1	1846 15 3	10673 13 2	29813 1 9
Cuddapah.....	10982 4 0	1593 14 0	938 12 0	4127 13 10	2436 2 3	20078 14 1
Ganjam	2391 11 1	437 0 0	.....	400 0 0	47 0 0	3275 11 1
Guntoor.....	12590 8 0	14659 1 7	6040 4 9	5519 12 11	2492 6 2	41302 1 5
Kurnool.....	1790 0 0	659 10 0	608 7 0	1108 2 0	3015 7 0	7181 10 0
Madura.....	24194 12 0	3580 0 0	311 2 0	1223 0 0	9540 0 0	38848 14 0
Malabar.....	.....	.....	.....	11735 8 8	18804 4 1	30539 12 9
Masulipatam.....	18231 10 0	69 7 0	4750 5 0	1219 15 0	4152 3 0	28423 8 0
Nellore.....	23855 13 0	12740 0 0	561 4 9	4338 0 0	.....	41495 1 9
Rajahmundry.....	27642 2 0	159003 0 0	2515 13 8	2995 8 0	6392 8 0	198548 15 8
Salem.....	10688 9 0	2614 0 0	704 9 0	2498 0 0	1775 0 0	18280 2 0
Tanjore.....	43198 13 0	13294 13 0	5461 5 0	7881 15 0	8408 1 0	78244 15 0
Tinnevelly.....	51340 3 0	14012 6 0	1866 4 0	10474 6 7	10656 15 2	88350 2 9
Trichinopoly.....	39474 2 1	10245 4 9	5673 2 8	1079 2 2	29795 1 4	86266 13 0
Vizagapatam.....	2596 3 0	11055 8 9	303 0 0	937 4 10	.....	14892 0 7
Total Rs... .	421713 0 9	230964 11 0	42960 6 5	76249 4 2	181627 4 10	994603 5 2

* Exclusive of expenditure under the Superintendent of Roads.

NOTE

OBSERVING that Government is anxious to keep open the Matabanga, so as to have a good water communication between the Hooghly and the Ganges at all seasons of the year, and that it yearly spends large sums of money with a view to obtain that desirable end, but up to the present time without any success, I have been induced to give my attention to the matter, as will be seen from the following pages.

1stly.—I will endeavour to show from established facts and natural causes, that it is almost beyond any human power to keep the river open at all seasons of the year, except at an enormous yearly expenditure.

2ndly.—I will endeavour to show that by converting the river into a navigable canal instead of contending against nature, by trying to keep it open, that the existing natural resources at our disposal will be so made use of as to insure the permanent success of the object we have in view at very trifling cost; and by making such diversions as are shown on the accompanying plan, that the course of the river will be so shortened as, during the inundations, to reduce the distance from Calcutta to the Ganges from 204 miles to 140 miles, and during the dry season from 508 miles to 140 miles; also that an unlimited supply of water may be had at all seasons of the year to feed the canal.

3rdly.—I will endeavour to show that by also converting the upper part of the Koomar into a navigable canal in connexion with the upper part of the Matabanga canal, a first-class navigation can be kept up all the year round at very little cost for the important traffic in existence between the upper part of the Ganges and the Soonderbunds, and generally to the East.

4thly.—I will endeavour to show from most reliable information that the income which would be derived from these canals, after deducting all working expenses and maintenance, would return such a large interest on the outlay, that there would not be any difficulty in raising the required capital independent of Government, with such support as the latter now seems disposed to give to such undertakings.
